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EDITORIAL NOTES.

The Meeting of the Gas Institute—Union in Sight.

THE Southampton meeting of the Incorporated Gas Institute, under the genial presidency of Mr. S. W. Durkin, must be recorded as completely successful, with a triumph of a not too serious cast. As we remarked on the programme of the meeting, Southampton is a pleasant place; and many members of the Institute evidently thought so, for they took their wives, and went prepared to enjoy the attractions so liberally provided by the kindly President. It is very gratifying to be able to testify that the technical work of the Institute did not appreciably suffer from this sensible lightening of the proceedings, which is to be esteemed a sacrifice to the *genius loci*. It is obviously impossible to cultivate on the headwaters of the Solent the austerity proper to many other erstwhile meeting places of the Institute that might be named. Certainly, the transactions were well up to the average standards both of interest and permanent value. The President's address placed no tax on the time of the gathering, or the attention of the members. Mr. James Swinburne's lecture was as good as anything of the kind could be, both in matter and presentment; and the papers ranged very acceptably over a wide field of gas engineering and managerial interest. If it is impossible for us to say truly that the work of the Institute was altogether commensurate with the present needs of the gas industry for guidance and development, that is no more than might have been remarked of the recent proceedings of the Institution. Patently, division has weakened both organizations.

For this reason, chiefly, it is tidings of much comfort that the members of the Institute heartily and unanimously agreed to the proposed resolutions designed to prepare the way for an amalgamation of the two national technical Societies. One would not like to assert that this vote, although in point of fact and of form only conferring upon the Council of the Institute identical powers for dealing with "members of the trading community" as have already been given to the Council of the Institution, was not understood by many as being an act of consentment to the long talked-of union. It was not, of course, anything of the kind; it was merely a step—albeit a long one—in this direction. But the meeting was clearly for amalgamation. Actually, both organizations have now found common ground upon which their responsible executive bodies can stand, with the single object of removing by common action the sole constitutional obstacle in the way of their union. This being so, with goodwill on all sides, there should be no real difficulty in bringing the business to a satisfactory conclusion. The desirability of union of the vital forces of the technical societies of the gas industry in this country is so extremely marked, and so thoroughly granted, that no petty quibbling over personalities will avail to stop its progress. Having regard to the conspicuous change that has come of late years over the spirit of many advocates of separatist organization—recognizing that times and men have changed, and that the object of these gatherings is nowadays taken far more seriously than was the case even ten years ago—there is reason to hope and believe that the reference to the two Councils will be read in the broadest sense. It is clearly not injuring any man to make him an honorary, instead of a subscribing and a temporary, member of a society. The device is perhaps open to some criticism on various counts; but the meaning is clear enough.

When the Councils of the two Societies have agreed upon such a measure of preparation as shall leave their ordinary membership qualification identical, the succeeding steps for sinking the two distinct organizations into a new one will be, with a single exception, matters of form. The exception will be the securing the assent of the members, or of a sufficient majority of the members, of each Society respectively, to the organic resolution which it will be necessary to pass. We cannot here state off-hand what form this constitutional action will take, as to which doubtless both Councils will be properly advised. There is much to be said in favour of the creation of a new body under a new name, such as "The Society of the Gas Industry," so as to obliterate all traces of the old root of bitterness, with a first President who has not been identified with either party in the past. There are many things awaiting the attention of the governing body of the new Society, when it shall be fairly started, which the old organizations either could not, or would not, touch. Among other matters, the relations of districts to the central body demand regulation. This is not the occasion, however, for going into such questions of detail. For the present, it must suffice to congratulate the personality of the gas industry in this realm upon being farther on the road to union in their own best interests than at any time in the past. For it ought not to be forgotten (as it sometimes appears to be) that the old British Association of Gas Managers did not embrace all worthy representatives of the industry. When, with the best intentions, this Association was expanded into the Gas Institute, the extension was distinctly one-sided, and for notorious reasons failed to satisfy the hopes of its promoters. Later the foundation of the Institution of Gas Engineers did something to redress the balance. Still there has always been present the uncomfortable knowledge that the separation of the followers of the gas industry into two distinct camps was a mistake. The time has come for rectifying it, absolutely and for good. It is not a question of going back to some imagined period of union which never existed. The golden age of the gas industry must be sought in the future, not in the past. It is to the young men who see fresh visions, and not to the old men who dream old dreams, that the entry upon a world of promise is offered as a possession. The associated gas industry is called to do more than, as well as differently to, anything which sufficed for it in the days that are gone, never to return. For those who grasp this truth, and will not rest content with the gratifications of the passing hour, association with the object of rendering and receiving mutual assistance to tread "the long road which "winds upwards all the way—even to the end," will require no supplementary recommendation. There is no reason why those who now have in hand this business of amalgamation should not set themselves the high task of improving upon all societies of the kind already in existence—of framing a model technical society, in short. Why not? There is plenty of room for it; and it is more profitable, and even more practical, to aim at a lofty ideal than to plod after the tail of the first passing caravan. The chemists, and the electricians, and the mechanical engineers, and the municipalizers of sorts have all done their shows passably well; and there is a plenty of them, as goodness (and Provincial Mayors) know well enough. The gas engineers and managers are not such a feeble folk that they cannot hope to do better than many, if not than most.

The "Builder" on the Testing of London Gas.

IT has on several occasions been admitted in these columns that the comments on gas topics of our contemporary the "Builder" are usually of a high order of intelligence. So much may be said of the passing reference made in the current issue of this periodical to the legislative proposals of the London County Council, mentioned by us last week. The "Builder" says nothing about the merits of the first two points of the attack upon the Gaslight and Coke Company—the standard price of gas and the extinction of obsolete capital—but expresses entire approval of the proposed reduction of illuminating power, as being a change "which "will be of material advantage to the majority of gas con-"sumers." With regard to the proposal of the County Council to move for a change of the testing clause of the South Metropolitan Gas Act of 1900, our contemporary very ingeniously remarks that when this question is reopened it will afford the gas engineers an opportunity "to remove "an injustice which has in recent years been committed in "recording the illuminating value of gas. Hitherto the "illuminating value of gas has been quoted as 3·2 candles "per cubic foot of gas consumed per hour. Under the new

"regulations, it will be only 2·8 candles per cubic foot. "Now, even with the so-called 14-candle gas, it is easily "possible to obtain an illuminating power of 20 candles per "cubic feet of gas consumed per hour by using an ordinary "incandescent burner. Electricians have naturally taken "the 3·2 candles as the standard value for gas, and were "able to justify their action by reference to the standard "fixed by Acts of Parliament. But the Gas Act relating to "the selection of the power used for testing very properly "stipulates that the burner shall be such as shall be the most "suitable for obtaining from the gas the greatest amount of "light, and shall be practicable for use by the consumer. "The burner at present used does not give one-sixth of the "amount of light now commonly obtained by consumers "from the light supplied."

This is the common-sense, outsider's view of the facts. The County Council have been moved to believe that if the South Metropolitan Company's gas had been tested in the fashion from which Parliament thought fit to relieve them, "or by a method which would probably be prescribed "by the Metropolitan Gas Referees for testing 14-candle "gas," the Company would have been substantially afflicted. This is letting the cat out of the bag betimes. What right have the County Council to forecast any decision of the Gas Referees? It is more than an impertinence, it is an insult on the part of the Public Control Committee of the County Council to the Referees, who are not their servants, to suggest that they have a prescription cut-and-dried for testing the gas supply of London in an unfair and illegal manner. The Referees could not, if they would, so manipulate the gas testing as to take away by photometry what Parliament has granted with full cognizance of the facts. They could not, for instance, prescribe the testing of gas by a flat-flame burner. To do so would be contrary to the intention of the Act of Parliament from which their own creation originates. They are bound to test gas to the best advantage, according to their knowledge, and the state of the art of burner construction The use of an incandescent burner for the purpose is, of course, out of the question, inasmuch as in this appliance the immediate source of light is the mantle, not the gas. Yet the suggestion for the use of such a test burner is more in accordance with the spirit of the law than the carping County Council suggestion that the preferable system of testing is one which depreciates the gas in comparison with the method already legalized in the case of the South Metropolitan Company. Perhaps this declared admiration for the obsolete and the defective accounts for some other curious vagaries of the London County Council. It is not a taste that Parliament is very likely to share. It will probably occur to irreverent persons that the County Council need testing as much as any of the objects of their antiquarian attentions. The photometers of 1871 and the fire escapes might well be consigned to a museum together.

The West Ham and Rickmansworth Bills.

Two more Gas Bills were disposed of in the Committee-rooms last week. The West Ham Bill was opposed to the last moment of going before the Lords' Committee, presided over by Lord Brougham, by the Local Authorities, who professed to be dissatisfied with the state of the measure as it left the Lower House. But the courage of the opponents failed them at the last; and their opposition was withdrawn, it is understood, as the result of the conciliatory attitude of the Company in regard to a few details of purely local importance. There remained, however, the pronounced antagonism of the two neighbouring Gas Companies of Ilford and Barking, which was inspired by fear lest the extension of the West Ham Company's operations, provided for by the Bill, should prove to be at their expense. It was a question of some indefiniteness of the old district boundaries, which, on its face, left the West Ham Company free to entertain applications for supplies to compete with the business of these Companies. The circumstance of no reference to district boundaries having appeared in the notices, debarred the promoters from consenting to anything relating to this subject being introduced into the Bill at the eleventh hour; but they were willing to give an undertaking that nothing should be done by them to alter working arrangements that have subsisted between them and their neighbours for nearly half-a-century. This voluntary promise was not regarded as sufficient by the opposition, especially because the new works of the West Ham Company are to be built directly on the opposite side of the district from the old site, and therefore next door to the debateable territory. It is one of the familiar difficulties of similar situations; but the Committee eventually listened to the appeal of the opposing Companies, and gave them a copy of the Chesterfield Joint Committee's clause for their protection. With this amendment, of purely local significance, the Bill was passed in its entirety, which may well be a matter of congratulation to the parties chiefly interested.

There was a sharp conflict in the Commons Committee on the Rickmansworth Bill, which was opposed solely by the Urban District Council in circumstances which have already engaged the attention of the High Court. It will be remembered that the District Council undertook to oppose the Bill without having previously gone through the formality of complying with the Borough Funds Act. The Court granted an injunction restraining the Council from spending the ratepayers' money in opposing the Bill in its earlier stage; but since then steps have been taken to put the procedure in order. The Company asked for a large extension of their capital powers, necessitated, in their judgment, by the fact that the whole district, which was also to be extended, has been put in the way of becoming more thickly populated by the improvement of its railway facilities. The Rickmansworth Urban District Council offered strenuous opposition to the increase of capital and the extension of the supply into what was alleged to be an unproductive region; and they also demanded the reduction of the present standard price of gas from 4s. 7d. to 3s. 9d. per 1000 cubic feet. The actual selling price is 4s. 6d. per 1000 cubic feet. There was a remarkable application in the Bill for sanction for the supply of "power gas," which was also opposed. The Council suggested that they should be given a purchase clause. The actual capital expenditure of the Company to the end of last year was £22,060; and the Bill asked for £75,000. The addition was admittedly large; but the incidents of the present application showed how onerous such proceedings are in the case of a small gas undertaking.

At the close of the evidence, the Committee suggested that the parties should come to an agreement. Pressed by Counsel, the Chairman (Sir John Brunner) indicated that the Committee considered the amount of capital asked for excessive, and were averse to the idea of allowing small isolated instances of the right to supply "power gas" up and down the country. Upon the resumption of the proceedings on Friday, the heads of an agreement between the parties were mentioned. It appeared that the costs of the legal proceedings were a stumbling-block to a perfectly amicable settlement. On their part, the Company were willing to reduce the new capital to £24,000, including the usual one-third loan; to give the District Council the Long Eaton purchase clause, operation up to the end of the current year; and to drop the "power gas" clause. On the other hand, the Council were willing to leave the standard price alone, but wished for their costs in the Chancery suit. The Chairman was particularly insistent that the parties should leave the room friends, and that no more money should be spent between them. In the event, they agreed to drop the Chancery suit, both sides paying their own costs. The Company's costs are not to be included in the value of the undertaking, in the event of purchase. Thereupon the preamble of the Bill was declared proved; and general opinion will incline to the judgment that the parties have reason to be thankful their affairs came before a Committee presided over by so competent a man of business as Sir John Brunner.

The Latest London Workshop Fire.

THE fatal fire in Queen Victoria Street last week, with its distressing incidents of inadequate Brigade appliances for the saving of jeopardized lives, has very naturally and properly made a profound impression upon the public mind. We have no desire to lay undue stress upon the circumstance that the premises were a sort of factory for the manufacture of electrical apparatus, especially as there is a total absence, for the time being, of information as to the cause and nature of the outbreak. Rather would one regard the fire in the general sense of a terrible reminder of the unseen and too often overlooked dangers which, so far from being reduced in consequence of the rapid development of our material civilization, seem to increase and be magnified with it. And also, the event cannot be dissociated from the peculiar reputation that the London County Council, who have charge of the Metropolitan Fire Brigade, are cultivating with a pertinacity worthy of a better cause.

For while this body glory in aspiring to an almost unfettered domination over one Metropolitan public service after another, the public see in a catastrophe of this kind presumptive evidence that they do not properly carry out the most obvious of the duties already laid upon them.

Those who are interested in the gas supply of London, for example, would be more than human if they did not contrast the meticulous care that is exercised by the London County Council over questions concerning the illuminating power and purity of the gas—matters which cannot really affect the life or the health of a single citizen—with administrative or official heedlessness as to whether the fire escapes kept in parts of the town known to be densely populated are long enough, or otherwise of the best of their kind. Why are the London County Council so alert on the point as to how the legal test-burner for London gas should be used, while such a state of things as that proved to have existed in the heart of the City, in respect of the danger to the lives of the people from the slightest fire, was permitted to continue? The answer can only be, that there are some tasks which public bodies of this order can perform better than others. They can worry the Gas Companies over microscopic deficiencies of illuminating power and purity, because these are matters of laboratory inquisition, and it is easy to find officials competent and careful enough to act according to the letter of the regulations made for such cases. It is much the same with the execution of the Building Acts. Once get your law, and appoint suitable officials to see to its being carried out, and a vested interest in keeping the enactment from becoming a dead-letter is at once created. When it comes to be a question of large prevision and policy, however, there is room for doubt as to whether the constitution of our local authorities is justified by its results in filling such bodies with the class of men very frequently to be found there.

To put the question plainly, who are now the members of the London County Council, that the public control of the greatest of all cities should be committed into their hands? There are good and able men among them, as may be freely granted; but is leading and influence always entrusted to those who are best qualified in all respects to wield the great powers of such an authority? It is notoriously not the case in democratic America, where quite recently some of the most important branches of City Administration have been taken from elective committees and put in Commission. Practical Germany, again, entrusts the actual management of large cities to specially trained men who are really experts. The elective authorities exercise a general supervision, as they do in France. It is hardly necessary to remark that the germ of the same system of administering local affairs exists in this country, and is comparatively highly developed in Scotland. The London Water Board, at present in course of being forged upon the parliamentary anvil, is of the same order. Such terrible occurrences as the Queen Victoria Street fire should warn perfervid municipalizers of everything, that there are other operations besides trading for profit for local authorities to engage in, and show them that the besetting evil of inefficiency in the discharge of those duties which only local authorities can perform, demands incessant vigilance to ward off.

The Benevolent Fund of the Gas Institute.

All told, there were about 220 members of the Gas Institute assembled in Southampton last week; but when the time came, at the close of the sitting on Wednesday, for the consideration of the report and statement of accounts connected with the Benevolent Fund, there was a mere handful of subscribers in attendance. As has been before complained, the time for the fund meeting to be held, for apparently no other reason than that it is the custom, is at the end of one of the ordinary business sittings, by which time most of the members have become tired of their confinement, and are anxious to satisfy the wants of the inner man. This may partially account for the small number who remained last Wednesday—the morning sitting having lasted for close upon four hours. It was not, therefore, at all an unreasonable act on the part of Mr. D. Irving to protest against the meeting being convened for such a time. Complaint was also made as to the lack of interest in the fund—not only from the point of view of attendance at the meeting, but also in regard to the financial support. Perhaps a healthier condition of things would accrue in both respects if the work of the fund was sandwiched in the ordinary business of the Institute, when there would be a fairly full meeting. Surely the Benevolent Fund stands next in its degree of usefulness to the technical work; and therefore should be accorded a prominent place in the proceedings, whether or not all present are subscribers. The fact that there would be numbers of non-subscribing members in attendance might have the happy effect of inducing many more, on hearing of the good accomplished by the slenderly supported fund, to come to its aid, and so increase its power as an active beneficent agent. The fund has done excellent work in materially relieving the necessitous in times past, and, with the growing prosperity of the gas industry, its competency in that respect should have also increased largely. After the remarks by Mr. Irving, Mr. Porter, and Mr. Ellery about the poorly attended meeting last Wednesday, it is to be hoped that a special effort will be made to ensure an extended interest—both personal and substantial.

Justice Triumphs at Bradford.

Though the principle of charging the street lighting on the rates (instead of on the gas consumers, as has hitherto been done) was some time ago agreed upon by the Bradford City Council as the right one to adopt, there has since been a good deal of discussion over the matter. The amount in question is a large one; the cost of lighting the streets of the city being about £30,000 a year. The charging of such a sum against the Gas Committee has naturally kept up the price of gas to a certain extent, and has thus made the finances of the department appear less favourable than they really were. In view, however, of the decision come to last week by the City Council, there will be less room for such confusion in the future, though even now the Gas Committee are not to receive payment of the whole amount which it is said the lighting of the streets costs. The Finance Committee recommended that £21,000 should be provided for the purpose, on condition that the price of gas was reduced 3d. per 1000 cubic feet; and this was agreed to, in spite of a resolution of the Gas Committee asking the Council to grant the sum of £28,000—the lowest estimated cost of the public lighting. Though the Gas Committee may not be altogether satisfied with this result, it at least has the advantage of proving conclusively the justice of the principle for which they have been contending. Every ratepayer will henceforth pay a share of the cost of lighting the streets, by which all benefit; and the gas consumer will, in consequence, be charged 2s. 3d. per 1000 cubic feet, instead of 2s. 6d., for his gas. The consumers will thus be benefited by the amount which non-consumers will now have to contribute (and which in fairness they ought always to have contributed) to the expense of public lighting. At the present time the change will make little or no difference to the finances of the Gas Department, seeing that what they are to receive from the rates they are giving away again in the reduction in price. This is, however, not the only point of view from which the matter should be regarded. The lowering of the charge for gas which has thus been rendered possible is an immense advantage to the undertaking, as it must inevitably tend to largely increase the consumption, and generally to popularize the use of gas for all purposes.

Burton's Milch Cow.

In another part of the "JOURNAL" will be found some statistics of the working of the gas undertaking of the Burton-upon-Trent Corporation in the past financial year, with the comments thereon of the Chairman of the Gas Committee, Mr. T. E. Lowe. It will be seen that there was a considerable drop in the profits, compared with the previous year, largely due to the lower price at which the residuals had to be disposed of—the returns from coke being £6409, against £8620. This, it appears, was due in large measure to the arsenic scare, which led the brewers of the town to "boycott" the Corporation's coke, which had to be disposed of at an exceptionally cheap rate to clear off stock. This, however, was not the cause of the "bitter cry" which escaped Mr. Lowe in the course of his statement. It was the gradual depletion of the reserve fund. A year or two ago it amounted to £16,596—not an exorbitant sum on a yearly turnover of £60,000. Now, however, it stands at £7571. The reason for this drop is that the fund is at the disposal of the Finance Committee, who, heedless of the needs of the Gas Committee, to whom it rightly belongs, draw upon it for every conceivable object, great and small;

and it even has to buoy up the electric light undertaking. This nibbling will in time reduce the fund to vanishing point. The Finance Committee, in their wisdom, not long ago decided to appropriate a sum of £6250 of the gas profits, which, however, turned out to be £1750 less than the amount drawn. Such financing as this needs reform. Mr. Lowe fully recognizes this, and suggests the appointment of a Joint Committee to control the reserve fund. This might have the effect of checking further drafts for objects which ought to be paid for from other sources. But a much better suggestion is made by one of the local papers —viz., that the Gas Committee should have the disposal of their surplus for reducing the price of gas, "so that the "consumers will no longer be indirectly taxed for the benefit "of non-consumers," or the financiers of the Council be permitted to "impose a fictitiously low rate," whereby they are enabled to partly hide from the public the actual cost of their management of municipal affairs.

Gas Supply on the Mediterranean.

The past year has been a very good one for the Malta and Mediterranean Gas Company; and the duty of the Chairman (Colonel Le Geyt Daniell) at the meeting last week was therefore of a pleasant character. There was an increase of 5 per cent. in the quantity of gas sold to be reported, as well as a large reduction in the cost of coal. The Company, however, like some others whose undertakings are situated abroad, occasionally find that it is easier to dispose of their gas than to obtain payment for it. Italian Municipalities are not as a rule very wealthy bodies; and the authorities at Trapani at present owe the Company a large sum (over £5000), which they have hitherto been unable to pay. The Chairman, however, stated that the Municipality were endeavouring to obtain an Act of Parliament which would enable them to raise a loan, and that he looked upon the debt as being absolutely good. This is not the first time the Company have had such an experience; and as things have before turned out all right in the end, there is good reason for anticipating that they will do the same again. The amount at stake is an important one for the Company; and it is to be hoped the Municipality will meet their obligation without much further loss of time.

Disputed Gas Accounts in Manchester.

The correspondence columns of the local papers give evidence of the existence of some discontent on the part of Manchester gas consumers with the accounts they are receiving from the department, which are said to show a "very general increase" for the March quarter over the corresponding period of the previous year. That the amounts should be somewhat larger cannot, however, be regarded as particularly strange, seeing that in the meantime there has been an increase in the price of gas. Perhaps this is a point which has not been duly considered by some of the people who are so anxious to rush into print whenever they may have a real or fancied grievance; though we are glad to see that it has not escaped the attention of all the writers of letters on the subject. When once an agitation of this kind is started, it is wonderful how quickly it spreads, and how unreasonable are many of those who take it up. Nothing that the gas company or corporation may be able to say or do seems to have the effect of "calming the "troubled waters;" and perhaps, therefore, the best plan is to let such outbursts die a natural death—as they will do in time. In the present case, however, one of the gas consumers of Manchester has taken the bold course of appealing to the City Magistrates to say that his account could not possibly represent the amount of gas consumed. We say "bold," because the correctness of the meter-registers was not really disputed—indeed, the defendant had himself had the meter at one of his two houses tested, and it was reported as "acting perfectly;" while the other house was in the charge of servants (whose gas-consuming proclivities are well known) during the period to which the account referred. Under the circumstances, it is impossible to question the soundness of the Magistrates' decision, that they had no option but to make an order for the payment of the amount claimed. It must be assumed that this gentleman is satisfied with having recorded his protest, for this is all the advantage he could reasonably have expected to derive from refusing to pay his account. To the Corporation, however, the case may be productive of more good, for it will serve to show those consumers who may not be already acquainted with the fact that it is of no use whatever making a fuss over their gas accounts unless they are prepared to prove that their meters do not register accurately. If they are unable to do this, the best thing is for them to "pay and look pleasant."

The British Engineer.

At the present time, when it is so much the fashion to belaud foreign methods of technical education, and to express pessimistic views with regard to the outlook for English engineers, it is very refreshing to come across an opinion which is in any way favourable to our country. Speaking at a recent meeting of the Derby Society of Engineers, the Chairman (Mr. F. J. R. Carulla) said it seemed to him that the present great outcry for technical education was in some measure a mistaken one. What we wanted was a better and more thorough primary education, so that everyone (including those intended for the engineering profession) should be better prepared to take up special lines of study. He thought that there must be some good in the English system, when the actual construction of the railways and other engineering works of the world were due to Englishmen. Brazil and the Argentine, he pointed out, owed their railways and their gas-works to William Bragge, an Englishman; while France itself owed its first railways to Mackenzie, who was also an Englishman. Indeed, he added, it is impossible to lay a finger anywhere on a map of the world without placing it on a spot where the work of some English engineer can be found. Though Mr. Carulla seems to have had the past most in mind, such a brilliant record as he shows English engineering to possess should be of good omen for the future.

WATER AFFAIRS.

Close of the Metropolitan Water Inquiry.

THE Joint Committee on the London Water Bill brought their labours to a close last Friday, after sitting four days during the week. The inquiry occupied rather less time than we supposed it would at the outset; yet the Committee gave altogether twenty-three public attendances. We regret that pressure on our space to-day necessitates the holding over till next week of the report of the final proceedings; but an indication of their nature may be gathered from the following summary.

When the Committee reassembled on Tuesday, they were asked by Mr. Fitzgerald, on behalf of the promoters, to deal with Schedule III., defining the constitution of the Water Board, which, it will be remembered, had weathered the storm which raged around it in the early stages of the inquiry. The London County Council submitted an amendment to reduce the number of members from 69 to 29, of whom 16 were to come from Spring Gardens. As an alternative, they proposed a Board of 33, on which the Council should be represented to the extent of 14. In support of these amendments, witnesses were called from Manchester, Liverpool, Edinburgh, and Glasgow, so as to show that the water undertakings in these cities were being efficiently administered by small bodies. For example, in Edinburgh, the water-works supplying a population of 429,000 were stated by one witness to be effectively managed by a body of 25 Trustees. This statement led Mr. Fitzgerald to set him the following sum in proportion: If 25 Trustees are required to manage one water undertaking supplying 429,000 people, how many will be required for eight, supplying 6,000,000? The witness, amid much laughter, said he failed to see the necessity for attacking the problem. This little incident was followed by the appearance in the witness-chair of Mr. W. B. Bryan, the Chief Engineer of the East London Water Company, as a supporter of the proposal of the promoters as embodied in the schedule. He expressed the opinion that, having regard to the different interests concerned, a Board of 69 members was not too large; and everyone of the municipalities concerned ought to be represented upon it. Owing to the magnitude of the work, it would be necessary to decentralize; and therefore he suggested the division of London into six districts, three on either side of the river, each of which, being as large as Manchester, Liverpool, or Glasgow, should be controlled by a Committee, with Sub-Committees in addition. The Earl of Crewe asked if the witness's

scheme had the support of the Local Government Board. Mr. Fitzgerald replied that he did not think they had gone exhaustively into the matter. Personally, however, he should attach great value to Mr. Bryan's view. After the arguments of Counsel, the Committee deliberated upon the two amendments, with the result that the first was rejected unanimously, and the second was lost by an equality of votes. They also decided not to increase the representation of Westminster. Tottenham and Hornsey were included among the bodies in the schedule; and this brought the sitting to a close.

In the course of the proceedings on Tuesday, a suggestion was informally made by a member of the Committee that if the representation of the Thames Conservancy upon the Water Board were increased—the additional member to represent the up-river districts—this might meet the views of Berkshire; and this was the first matter considered on Wednesday morning. Sir Frederick Dixon-Hartland, the Chairman of the Thames Conservancy, was called to give his views on the suggestion; and he expressed the opinion of the Board that the effect would be to take away the whole value of the extra representative. The object of having another member was that they might always have one to speak for them as a whole on all questions before the Water Board. The allocation of one to the Upper Thames would divide their power. There had been no antagonism between the two divisions of the river; and he could not see why this condition of things should not continue. Mr. Balfour Browne, on behalf of Berkshire, asked the Committee to adopt the suggestion made to them. He pointed out that the Thames Conservancy were paid a large sum to keep the river pure for the benefit of London; and they very properly kept a sharp eye upon those counties in which were the sources of water—Berks and Wilts being two of them. It was only right, therefore, that they should have some voice upon the new Board. After deliberating upon the matter, the Committee decided to add two members to the representation of the Conservancy (making three in all), one of them to watch over the interests of the up-river districts. But they were unanimously opposed to making any change in regard to the River Lea. The Chairman added that the schedule, as amended, would stand part of the Bill; and that the process by which this decision had been arrived at would form the subject of a special report. The various changes made in the constitution of the Board brought up the total number of members to 71 instead of the original 67; and clause 1 of the Bill was amended accordingly.

The next matter considered was that of outside representation upon the Board; and on the application of the Middlesex County Council, the first paragraph of the fourth schedule was deleted, and the constituent authority of each district was left free to select their representative apart from their own members. By this decision greater continuity will certainly be secured, because a member of the Board will not necessarily lose his seat thereon if he happens to fail in his re-election on the body which originally sent him. Moreover, it will allow of the utilization of the services of some of the present Directors of the Water Companies, whose knowledge and experience would be invaluable to the new Board. At the same time, as Lord Balfour was careful to point out, the amendment cut away a good deal of the argument about the representatives being "in touch with their constituents." A rather funny incident arose in connection with this amendment. On the first count, as recorded by the Committee Clerk, it was declared rejected. But it was found that he had misrecorded the votes; and, amid some amusement, the decision was reversed.

A long discussion then took place on the clause of the Bill dealing with the creation of a water fund to meet the expenses of the Board, and providing that any sum required to meet a deficiency should be apportioned between the City of London, the parishes in the County of London, and the outside boroughs and urban districts represented, in proportion to their rateable value. On behalf of the London County Council, two amendments were submitted—one to include rural districts, and the other to omit the provision that the proportion of payment should be according to the rateable value of the hereditaments supplied with water. This matter was before the Committee at a previous sitting, and they then asked for a table to be prepared showing the effect of the amendments. This was put in, and Mr. E. J. Harper, the Statistical Officer of the London County Council, was examined thereon. There was a general demand for the rejection of the amendments, for reasons which were fully stated by Mr. Fitzgerald and the other learned Counsel. In the result, the Committee refused to accept both—the first by an equality of votes, the second by a considerable majority. An amendment was next submitted to the effect that the Water Board should not reduce the rates below those in force during the quarter ending June 24, 1902, if such reduction would be likely to cause any deficiency in the water fund. The amendment was accepted, notwithstanding an emphatic protest from Mr. Balfour Browne, on behalf of the London County Council; and with this ended the labours of the day.

The matters dealt with by the Committee at their last two sittings do not call for notice at any great length. On Thursday morning, the Committee took up the consideration of clause 13, relating to the issue of water stock. Mr. Pember, on behalf of the Water Companies, proposed to add a schedule of regulations to govern the issue. It was opposed by Mr. Fitzgerald, and rejected by the Committee, who, however, ordered a proviso to be inserted requiring the conditions governing the issues of stock to be identical, except as to periods of redemption. In compliance with a previous request of the Committee, Mr. Fitzgerald brought up a new sub-section to the arbitration clause (18), the effect of which was to allow of an appeal to the House of Lords on a question of law, "with the leave of the "Court of Appeal, but not otherwise." The proposal was objected to by the Companies and by the London County Council, on the ground that it would allow the Court of Appeal to make its decisions the law of the land. The Committee, however, decided to pass the sub-section, with the addition of a proviso that "the Court of Arbitration shall "act in accordance with the decision arrived at in any such "case," and giving the Court power to deal with costs. On the clause dealing with the existing officers and servants of the Water Companies, an amendment was accepted to the effect that Mr. Walter Hunter, the Engineering Director of the Grand Junction Water Company, should be entitled to a pension equal to two-thirds of his average salary and emoluments for five years prior to the transfer of the undertaking, if he ceased to be an officer of the Board; and also one fixing sixty years as the age at which an officer could claim compensation. A provision was inserted in the Bill to ensure that Sir William Crookes and Professor Dewar should be taken over by the Board as "existing officers," if, on the transfer of the Companies' undertakings, they should still be employed in carrying out the chemical and bacteriological examinations of water with which their names have been so long associated. In connection with these examinations, an amendment was accepted, on the proposition of Mr. Baggallay, that they are to be continued by the Board, who will have to provide the necessary buildings, apparatus, and staff to enable them to be conducted efficiently. Mr. Pember, on behalf of the Companies, then brought up the fifth schedule, dealing with the distribution of the compensation awarded in respect of the transfer of any undertaking, and some time was occupied considering certain suggested amendments to the clause referring to the liability of the Board for the costs in any proceedings under the schedule. In the end, the schedule was passed without the clause, which it was considered had been covered by the one in the Bill relating to the arbitration proceedings. A few other matters were next disposed of, and the protracted inquiry closed.

The Bill, as amended, will now be reprinted, reported, and then come before the Houses for third reading. Whether it will pass or not will depend in a great measure on the opposition it will encounter at the next stage of its progress. As Lord Salisbury told the deputation who waited upon him on Wednesday, it is the intention of the Government to bring the controversy on the London Water Question to an issue of practical legislation within the present session; and they are relying upon the support of those who command the majority in the House of Commons to further their efforts to attain this object.

Prevention of Spontaneous Combustion of Coal Stored in Heaps and Bunkers.—Dr. D. Morck proposes, in the "Zeitschrift für Heizurgs, Lüftungs, und Wasserleitungstechnik," to cool the interior of a heap of coal by interlaying the coal with good heat conducting substances, with the object of carrying off the heat developed to the exterior. For this purpose, metal pipes can be used, through which cold air, water, liquid carbonic acid, &c., are passed.

THE

INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-NINTH ANNUAL GENERAL MEETING,

HELD AT THE

ROYAL VICTORIA ROOMS, SOUTHAMPTON,

JUNE 10TH TO 12TH, 1902.

Mr. S. WESTALL DURKIN, President.

REVIEW OF PROCEEDINGS.

BEFORE inviting the attention of readers to the Summary of Proceedings on p. 1635, which gives a general idea of the transactions at the Southampton meeting last week, there are (as in previous years) a few observations to be made on the President's Address and the papers read, in order to bring out the salient points of these compositions for the guidance of the technical reader, without attempting to exhaust the interest of the matter itself, or to weigh the effect of the discussion to which it may have given rise.

The Inaugural Address of the President was largely of an individual character, obviously suggested by the not very common circumstance that the present happens to be the fiftieth year of Mr. Durkin's service with the Southampton Gas Company. This record naturally aroused in the presidential mind a reflection upon the altered conditions existing when he entered the gas industry, and those prevailing at the present time, for the training and instruction of young men in their chosen career. The President's words on this head remind one that there are many other callings besides that of gas engineering and gas-works management of which the same might be said. In a seaport town, the analogous case of sailors jumps to mind. How different, might one remark, are the opportunities of learning his trade now offered to a young man who elects to "follow the sea," from those with which his precursors were obliged to make shift! Yet, after all, the essentials of success in any responsible employment remain unchanged from generation to generation. Keenness to learn what ought to be learnt, and steadfastness in the performance of dull routine duties, combined with integrity, will carry men as far nowadays as they ever did; and without these qualities all other equipment for the race of life is worse than useless.

Southampton being a growing town, the gas-works have been expanded and improved to satisfy the requirements of the district. This is as much as can be said in commenting upon one part of the address. Mr. Durkin explained the reason why the Southampton works have not adopted gas furnaces and mechanical stoking; and he offered some considerations favouring the plan of dividing "through" retorts in the middle, as compared with working them according to the system implied by the name. This is a point of practice which has often been discussed cursorily, but never completely threshed out. The truth of the matter probably is that the standard English length for through retorts was accidentally arrived at by the growth of the fashion of placing the benches back to back. This was done chiefly, we have always understood, for the sake of economy of fuel and also of ground space. The fact of one ascension-pipe of the two usually provided for through retorts doing the whole or most of the work, has not been ignored; but, owing to the diversity of conditions existing in various works, this has been differently regarded in different places. It is, as has often been remarked in the "JOURNAL," a curious truth that Continental and other foreign carbonizing practice has never adopted the English 20-foot "through" retort as the standard; and no exhaustive statement has yet appeared reviewing both practices, and definitely establishing which is the best length for a retort under particular conditions.

The President had a good word to say for carburetted water gas on the score of high production for the ground space occupied, which is a serious question at Southampton. He cannot state precisely what it costs to make; but he is evidently satisfied with the auxiliary product on the whole. Curiously enough, he does not find that the mixture of the two gases is a cure for the naphthalene trouble in the district. The prepayment system is in force in Southampton, and is doing well. Mr. Durkin had a couple of examples of electrolysis and some illustrations of the effect of a short-circuit to show, by way of leading up to Mr. Swinburne's lecture. Towards the end, the address became what it is no disparagement to designate "scrappy." Street lighting, the local fortunes of the incandescent gas-light, the circumstance of electric light being supplied by the Corporation at a loss, and the naphthalene trouble, all received a few words of mention, but not to the raising of any question. It is pleasant to hear that Mr. Durkin has gratifying experience of the well-known "Hastings" process for the prevention of naphthalene deposit in a particular district once plagued by it. The President claimed that his address was "more managerial than engineering." However, he is not to be reproached for this; and it is, besides, as well to have every side of the gas industry exhibited on suitable occasions. The address achieves the distinction of being one of the briefest on record.

Mr. Dugald Clerk's paper on "Large Gas-Engines and the Gases Used by Them," which was the first one taken, is to be regarded as an appendix to the author's book upon the gas-engine. When reviewing an edition of this indispensable work which had a chapter with the title "Large Gas-Engines," we were constrained at the time to remark that the contents of this chapter were like the celebrated one in a work on Natural History, entitled "The Snakes of Ireland." A good deal has happened since then, and at the present moment a gas engine of 1000-horse power is running on producer gas, in the absence of the blast-furnace gas for which it was designed, at the Düsseldorf Exhibition. Mr. Clerk mentions others; and it is worthy of notice that they all use blast-furnace gas—that is to say, not a gas specially manufactured for the purpose. Mr. Clerk shows that what the gas-engine requires is the cheapest possible gas per unit of heat contained, with relative disregard of flame temperature. This, it is to be noted, is the diametrically opposite requirement from that of the Welsbach burner. Mr. Clerk referred with pardonable pride to the fact that his original predilection for the two-cycle type of engine is now being justified by the success of this system upon the large scale. It is also interesting to note that so competent a judge is very favourably impressed with the Oechelhaeuser gas-engine. Mr. Clerk left himself but little time to discuss the gases which supply large engines, apart from blast-furnace gas; but it is important to record that his opinion of the prospects of Mond gas for this trade, as a special manufacture, remain unfavourable. On the other hand, he unreservedly endorses all that has been advanced in this connection by the pioneers of cheap low-grade gas produced from ordinary coal.

The next two papers dealt with aspects of the economics of gas distribution and the business of selling gas. Mr. Norton H. Humphrys, of Salisbury, is so old a hand at the work of popularizing gas for the service of the community, that it is unnecessary to claim respectful attention for whatever he may advance on the new aspects of the commercial side of a gas company's work. His present paper is short, and is wholly devoted to the explanation of the system of incandescent gas lighting which has proved successful in meeting the conditions brought about by the reduction of gas consumption due to the incandescent light itself, the energetic pushing of electricity, and the stagnation of the population. We can heartily support Mr. Humphrys' main contention that "maintenance," when it is undertaken at all, ought not to be an overtime job, offered in a half-hearted fashion, but should be gone into with a will and the intention to succeed. Mr. Robert Watson, of Hertford, supplemented Mr. Humphrys with a well-reasoned paper, in which all the pertinent considerations favouring the undertaking, by such a Gas Company as that of Hertford, of a complete consumers' fittings department were brought forward. Mr. Watson takes the opportunity of ranging himself on the side of low-grade gas, which he holds "makes the direct interest of a company in fittings keener and more important."

If we approach the criticism of the lecture on "The Electrolysis of Gas-Mains," by Mr. James Swinburne, with some diffidence, it is not because there is any real difficulty in following anything that Mr. Swinburne says, but because of the playful convention commonly adopted by the electrical

journals when mentioning any of the observations that may appear from time to time in these columns in relation to matters electrical, which is simply to pretend that these are always and utterly worthless. It is the pleasing habit of these contemporaries of ours to assume that we cannot put two and two together when the question is an electrical one. Wherefore it is in a duly chastened spirit that we take up a duly humbled posture, so to speak, at the feet of Mr. Swinburne, in the full and complete conviction that, whether it occurs to us to agree or to disagree with him, we shall be absurdly wrong in the judgment of electric journalists. So far as Mr. Swinburne himself is concerned, the danger is not so great. He was in a gas-works before he addressed his exceptional mental powers to the advancement of electric engineering; and he does not wholly despise those who have stuck to the old shop. Moreover, there is reason to believe that the praise or blame of electric journalists affects him as little as it does the "JOURNAL;" so there is some common ground between us.

Mr. Swinburne does not make light of the electrolytic trouble. He discusses it in the plain, homely language which is so characteristic of him, and makes him beloved of His Majesty's Judges, who can always understand him, even to disagreeing with what he says. No man ever knew James Swinburne fence with an awkward question. He admits in his lecture that it is extremely difficult to describe truly what goes on underground when electric currents that have driven tramcars are on their way home again. He gets down to the point that a gas-pipe can only be corroded by such means where the current is leaving it, to pass into damp ground. And where the current leaves the tramrails to get into the gas-pipes, it must corrode the former. Hence the first warning to expect corrosion of the pipes, which are not seen, is corrosion of the metals, which are visible. It may not follow that electrolysis of the mains, whether gas or water, is equal to that of the tramway rails; but where one exists the other is to be predicated. Inasmuch as prevention is better than cure, all manner of expedients, enumerated and described by the lecturer, are made use of to keep return currents from finding their way into gas and water mains. It would be quite impossible to paraphrase to advantage Mr. Swinburne's remarks upon this head. It only remains to notice the conspicuous fairness of his conclusions on the whole matter; and we trust we are not doing him an ill-turn with his electrical brethren by testifying to the value of his lecture from the gas engineering point of view.

Mr. W. D. Child, of Romford, had occasion to consider carefully how he was to drive the air-fans required for his carburetted water-gas plant; and, for reasons which he states in his paper, he decided to try the De Laval steam turbine. He is well satisfied with the result. This is substantially what his paper amounts to; for the rest is merely a recapitulation of the design of the motor, with which mechanical engineers are by this time well acquainted. What is fresh, however, is the information that the De Laval turbine is actually and considerably more economical of steam for blower work than a high-speed reciprocating engine. Mr. Child's suggestion that the work of exhausting gas might be done in this way is worthy of attention, particularly as the separation of the tar from the gas might be effected centrifugally at the same time.

It is difficult to say anything fresh about the subject of such a paper as that of Mr. R. G. Shadbolt, of Grantham, on "Sunday Rest for Gas Workers." The title of such papers used formerly to be "Sunday Labour in Gas-Works;" and the industry is to be congratulated on the change. Mr. Shadbolt has fairly made good a claim to rank as a missionary in this cause; and if, like all missionaries, he occasionally drops into a little *ad captandum* sentiment, it will be forgiven him for the worthiness of his object. It cannot be thought that the good work is nearly done, when it is known that about one-half of the gas workers in the United Kingdom at the present time have no knowledge of Sunday. How the shareholders of gas companies, the directors, the ratepayers of municipalized gas-works, and the gas committees where this heathenish superstition persists, can go to church or chapel with a clear conscience, knowing what is done at the gas-works by their implied consent, must be left to them to settle. What is local opinion about, where such a state of barbarism continues? Does it not occur to any reverend gentleman to make a surprise visit to the gas-works in which he may be interested? Mr. Shadbolt is to be complimented upon the thoroughness with which he has done his part in advancing this cause, which, as one of his correspondents truly says, it is the "plain duty" of every self-respecting gas manager in this country to help forward; and it is to be hoped that a print of his valuable paper will go to every religious publication in the land, as well as to all the bench of Bishops, and the heads of the Churches not of the Establishment.

Mr. Walter Hole, of Leeds, took up a subject allied to that treated by Mr. Humphrys; but he hails from a part of the world as different as is possible in the same land from the quiet cathedral city of Salisbury. He accordingly dealt in his paper with a special, but not exactly peculiar, set of questions capable of being grouped under the name of gas distribution—ruling out everything beyond the consumers' meters. His was a study of trunk mains extension, with regard to economy and efficiency. His matter was fairly good, and his style lively and pointed. His chief claim was for the use of longer cast-iron mains, up to 15 feet in length, which he vouched for as being procurable on sufficient demand being forthcoming. Among other suggestive points, Mr. Hole mentioned experiments with an expanding alloy for jointing socket pipes, and discoursed informingly upon a variety of main and service layers' "wrinkles." He recommends "exploders" for clearing out service-pipes; expresses a modified approbation of subways (reducible in essence to the proposition that they should only be used for trunk mains); and he is somewhat nervous in regard to electrolysis.

Mr. John P. Leather's paper on "The Valuation of Gas Oils" is an *addendum* to the author's recent joint contribution with Mr. Raymond Ross to the Society of Chemical Industry at Manchester, the chief portions of which were given in the "JOURNAL" last week. These are valuable additions to the available stock of information respecting the constitution of market gas oils. He finds that the percentage of paraffins and olefines present in a gas oil determines its value; but, unfortunately, the determination of this factor is not a very simple business. Indeed, the best method is not yet worked out; but Mr. Leather promises that it shall be done. Meanwhile, he highly recommends analysis by gasification on a laboratory scale, the same as is done with coal. The paper is peculiarly valuable on this account. Indeed, we venture to judge that, as regards the quality of instructiveness upon a very important point of oil-gas manufacture, this will be found the most useful paper of the meeting.

Mr. C. E. Jones's paper, raising the question: "Is the Gas Capital in England and Wales Excessive?" was one of the most ambitious contributions in the list of the meeting, posing as it does a problem of the greatest importance in regard to the higher politics of the gas industry. Though beginning in a vein of rhetoric which is characteristic of the author, this preliminary flourish should not prejudice, or overshadow, the shrewd common sense which marks the gist of the matter. The first positive conclusion formulated by Mr. Jones is that many British gas undertakings are over-capitalized, which condition, he hastened to avow, is not confined to gas companies. Any number of blacks, however, do not make one white; and the only pertinent inquiry is, assuming the fact of over-capitalization in the case of a gas company, how this evil may be cured. It will be observed that the question is put in the case of companies only, for a sufficiently familiar reason. The circumstance reminds us that the same problem has before now been stated in the editorial columns of the "JOURNAL" without advancing it towards a solution. As many others, Mr. Jones fails to see why Parliament should make such a difference between the finances of local authorities owning gas-works, and gas companies; and he shares the common lot in failing to supply a convincing reason for the practice. He appears in one place to overlook the influence of the consideration with which he starts his contention—that it is the excess capitalization of gas companies that ought to be wiped out wherever it exists. Local authorities must redeem the whole of their capital debt, whether excessive or otherwise. Many reflections arise out of this disparity. It throws upon gas company reformers the onus of proving excessive capitalization, which is a grave obstacle to any fruitful application of the principle. Besides, there is the question of degree. Where the amount of over-capitalization is small, it becomes of academic interest only; where it is large, it is unmanageable. In view of coming events in regard to the London Gas Question, we do not think it expedient to discuss this subject too pointedly. There is a great deal of practical interest in Mr. Jones's paper, apart

from this thorny topic. He is to be thanked for, among other services, employing a happy phrase to describe the modern uses to which so much lighting gas is put, for which nominal illuminating power is not of great moment. He says, very truly: "To produce gas of high illuminating power for the purpose of bunsenizing is a waste of energy." 'Tis a good word—"bunsenizing"—and it sums up the use very neatly. He makes a little slip, by the way, in remarking that lower-grade gas is actually of equal, if not superior, calorific power "to its richer olefiant brother." That is not so; and the opening must not be left for the admission of a reactionary argument. Again, the author states erroneously that gas-works situated within the Metropolitan area, or "Greater London," are under the Gas Referees. Only the three distinctively Metropolitan Companies are subject to this jurisdiction; companies serving what is commonly known as Greater London being free of it—to their unspeakable comfort.

Two papers of the same order, each describing a particular piece of gas apparatus, can be mentioned together, inasmuch as they are not debateable on the ground of opinion. Mr. T. G. Marsh, of Manchester, is to be praised for endeavouring to break through the cramping limitations of the established practice of metering gas. Whatever the merits of Mr. Thorp's "Rotary" meter—as to which, of course, it is as impossible to pronounce judgment as it would be unfair to excite prejudice—it is unquestionably a most admirable attempt to get out of a rut, and improve the method of measuring gas. Looked at in one way, the station meter is a monstrous piece of apparatus. Speaking generally, there has been remarkably little real invention exercised in the department of gas measurement since the splendid creation of the meter-drum by the genius of Clegg; and there is plenty of room for it. The station meter is not deserving of the exalted place it usually occupies in a gas-works—to judge from the semi-religious sort of seclusion and the wealth of ornamentation amid which it is not seldom enshrined. It belongs essentially to the same order of appliances as the switchboards of electricians, which again are vastly expensive accessories to the manufacturing plant, and do not earn their keep. Mr. W. R. Mealing brought forward what is an old will-o'-the-wisp of gas managers of an inventive turn—"The Automatic Lighting and Extinguishing of Public Lamps." The purpose of his paper was to commend to expert notice an appliance invented by Mr. John Gunning, of Bournemouth, who has proceeded upon the separate system—that is to say, effecting the independent operation of every lighting point by means of a self-contained mechanical device for turning the gas off and on. The arrangement involves the use of a pilot-light, and it depends on the action of clockwork, which is to be set to the varying hours of lighting and turning off at weekly intervals. It appears to be well spoken of in the district of its origin, and should be deserving of more extensive trial.

It will be seen from this cursory review that the subject-matter of this year's Institute papers is very various, and agreeably covers a great deal of the ground of contemporary gas engineering and management. The absence of communications on inclined retorts and machinery for saving labour in gas-works is noticeable; but it will perhaps be felt as a relief by those technicians who have lately been overwhelmed with this class of subjects.

The members of the Gas Institute last week found the Mayor of Southampton (Mr. F. A. Dunsford) a genial man, and good at repartee. During the speeches made after the luncheon given by the Gas Company to the members on Tuesday, Captain A. J. Corse-Scott, one of the Directors, remarked that never before had the Company been in such a prosperous condition as at the present time. "The Trade and Commerce of Southampton," was a toast subsequently honoured. The Mayor, in his acknowledgment, referred to the happy coincidence of Mr. Durkin's presidency of the Institute and his jubilee in the service of the Southampton Gas Company. Captain Corse-Scott's little revelation as to the prosperity of the Company was then smartly turned to account by his Worship, who suggested that the time was favourable for a reduction in the price of gas, upon which Mr. Crowther Smith, the Secretary of the Company, interposed the remark that the Corporation should make a concession in the price of the electric light. To this, his Worship laughingly retorted that unfortunately the Electric Light Department did not pay maximum dividends, and was not in a position to build palatial offices.

THE PROCEEDINGS SUMMARIZED FOR BUSY MEN.

(*The Usual Full Report Commences on p.* 1646.)

From all parts of the country—from the North, the East, the West, and the South—travelled the members of the Institute to Southampton last Monday. Distance appeared to be no object; and the circumstance of having to travel from early morning to late at night in many cases did not apparently occasion the slightest distress. Tuesday morning broke at its best. The sun shone brilliantly; and over Southampton Water a great calmness reigned. "Peace and goodwill" seemed to be the message of the morning; and the peaceful voice of Nature indeed appealed strongly to the visitors. Conversations here and there before the meeting naturally turned to perhaps what may be termed, without offence to those who provided other items, the chief event of the day for the gas industry; and the tenor of these conversations foreboded well for a satisfactory vote later. This fortunately proved true.

By half-past ten the members had assembled in the Royal Victoria Rooms, where the business proceedings were to be conducted. The ample hall was comfortably filled, there being only a few rows of vacant seats at the back. A little relief and animation was given to the scene by the presence of a number of ladies accompanying the members. On the platform with the President (Mr. S. W. Durkin) were the Mayor (Mr. F. A. Dunsford, J.P.), and the Chairman (Dr. T. W. Trend), and other Directors of the Gas Company. The acclamatory demonstration welcoming these civic and industrial rulers, as well as the Institute's leaders, having subsided, the Mayor, in graceful language and manner, gave the members a most cordial welcome. Dr. Trend supported his Worship in kindly words, which were but a foretaste of a more tangible form of reception by the Company to be enjoyed at the conclusion of the morning's business. But we must stay to say here that Dr. Trend told the visitors that, within a few months, Mr. Durkin would complete 50 years of service at the Southampton Gas-Works. He rejoiced that Mr. Durkin had attained such a well-merited position as President of the Institute, and congratulated the members on having such a President. There were approbative cheers; and then the President, in the name of the members and on his own behalf, brought this pleasant little prelude to a close.

We may pass quickly over the succeeding formal business, which comprised the adoption of the annual report of the Council, the election of Mr. H. Wimhurst (Sleaford) and Mr. E. D. Sapey (Horsham) as Scrutineers, and the adoption of the annual statement of accounts. Then we come to the only melancholy part of the whole meeting, and that was, when the President invited the members to place on record—as they did with the sorrow that an irretrievable loss compelled—their deep sympathy with Mrs. Chester and the family in their sad bereavement. It was sufficient for the President to merely move the resolution, for there was no necessity to remind the members of the valuable worker they had lost by the death of Mr. Chester. This recalls to mind that the report, which had been taken as read, bore a substantial list of names of members who have been called hence during the year; and some of them incomparable workers in their own particular ways. The names of Mr. William Carr and Mr. Charles Sellers may be specially mentioned.

But turning to more genial subjects, the President next presented the premiums in connection with the papers read at the last meeting. There is particular pleasure in congratulating Mr. Walter Grafton on having been awarded the first premium—£10 and the President's medal—for his paper on "The Effect of Quality and Pressure on the Efficiency of Incandescent Gas Lighting, having Regard to Economy." Mr. Grafton is a quiet but successful worker in the gas industry in more than one direction; and this recognition of the paper, which was composed of good debateable material, was well deserved. Mr. Robert Porter, notwithstanding the severe handling which he and his paper received at the last meeting—he having dealt, it will be remembered, with "British Water-Gas Practice" as seen through his own particular glasses—was awarded the second premium (a cheque for £6), and he went up manifestly highly amused at the fact that he had received an award. The third premium (a cheque for £4) fell to Mr. William Sugg for his paper entitled "High and Low Pressure

Gas Incandescent Lighting." Mr. Sugg was not present to receive his reward from the hands of the President nor the plaudits of the members, which, on these occasions, are always most generously bestowed.

Hastening on Unity.

Then came the great event of the meeting. For a moment or two, there was the usual *sotto voce* interchange of views, which seems to be the inevitable precursor of the actual arrival of the time for the consideration of any important topic; but immediately the President rose, there was absolute quiet. He submitted the resolutions in the same terms as they were passed at the recent meeting of the Institution. The first resolution proposed the admission to the class of honorary members of such members of the trading community as shall, in the opinion of a clear two-thirds majority of the Joint Councils, have rendered distinguished services to the profession of gas engineering, or have specially promoted the interests of the gas industry. The second resolution provides that existing members of both Societies, who (having ceased to hold positions as engineers or managers of gas undertakings) would be ineligible under the proposed new rules, shall be dealt with under the terms of the first resolution; and that those existing members of both Societies acting solely in the capacity of secretaries of gas undertakings shall be eligible for election as associate members of the proposed new Association. The mover of the adoption of these proposals was the President, and the seconder Mr. Andrew Dougall; and both speakers were moderate to the extreme in their remarks. The point of the President's observations was that he hoped the members would have confidence in their Council to carry on the deliberations; and Mr. Dougall gave a direct indication of the feeling of the Council on the subject when he said: "We, as a Council, are unanimous in asking for this power." The request of Alderman Miles for an explanation concerning the second resolution looked at first like a stepping-stone to opposition. Many members, he thought, do not quite understand the nature of the gauntlet they would have to run to obtain re-election; and, in his opinion, it would be a great pity if members, whether distinguished or not, should feel there is any likelihood of their being debarred from the privileges of an Institute with which many of them have been for so long associated. No one can long more ardently than he for amalgamation; but his great hope is that it will be on "right, just, and equitable lines." The President assured Alderman Miles that he might safely leave the matter in the hands of the Council. The resolutions were about to be put, when Mr. W. W. Hutchinson and Mr. C. Stafford Ellery both interceded for a little more information as to what would ensue from the passing of the resolutions. The President made it clear that the Councils will at once confer together; and whatever is done will be submitted for the confirmation of the members. Again Alderman Miles interposed; and a neat little speech by Mr. Charles Wood in reply gave just the finishing touch of assurance needed to induce the members to give a unanimous vote. Mr. Wood is a member of the Council of both bodies; and, as such, he was able to say that both Councils are in favour generally of re-electing every member who has been a gas engineer. The vote was then taken; and it must have passed the expectation of everyone who was present to find not a single recusant member present himself to prevent the President announcing that the resolutions were carried unanimously. The road to absolute peace and unity now looks straight and clear.

The Inaugural Address.

The part of the proceedings which might peradventure have been the most untoward having been thus passed through so successfully, the President was able to approach the delivery of his address with rather more cheerfulness than he had evinced during the earlier portion of the meeting. The address was published in last week's issue, and it is fu rther noticed elsewhere. The remarks in the first section of the address, as to the want of advantages for securing proper training in the President's early years of work turned back the memories of many of the older members present, and reminded them of their struggles years ago to obtain proficiency in their work. Starting in this way, it was fit the address should end with an appeal to "young men to make use of every advantage at their disposal to be fully equipped for the conflict before them; for knowledge is power, and a good character is better than riches." This observation, and much else in the address, harmonized completely with views of the President's heedful audience. Upon Mr. W. A. Valon fell the honour of proposing a vote of thanks to the President; and Mr. John West seconded. Mr. West found the President's story of his early wrestling for instruction to completely tally with his own experiences. Confirming what we have recently advanced in these columns, he pointed out that much more is expected of the gas engineer of the future than was expected of the engineer of the past; and therefore he advised young engineers to "fill themselves to the brim" with all the knowledge they can. The proposition was carried by acclamation.

Without delay, a commencement was made with the technical contributions. The first of these was by Mr. Dugald Clerk; and it was on

Large Gas-Engines, and the Gas Used by Them.

Although the communication was styled a paper, and was subsequently discussed as such, Mr. Clerk's method of delivery was more that of the professional lecturer and instructor than that of a reader of a paper. He is, as all readers must be well aware, a leading light on this subject; and although he had committed to writing what he had to say, he is such a master of his theme that he could not restrict himself to the confines that he had marked out. The paper, however, did not by any means suffer from this; on the contrary, the manner of treatment rather added to its interest.

The author's opening passage struck the hearer at once; stating a fact of which few have taken heed. It was that the large gas-engine has arrived at an interesting and critical stage of its development at a time when the conditions of coal gas manufacture are also changing—when gas engineers are seeking new standards of the qualities required in coal gas. Welsbach's invention has supplied a new standard in one direction; and the growing importance of the gas-engine introduces new requirements in another direction. In short, Mr. Dugald Clerk asserts, without any qualification, that the welfare of the coal-gas manufacturing industry requires the production of a gas which will satisfy alike the requirements of light, gas power, and gas heating. He says broadly that the incandescent gas light needs, for the best economy, gas capable of yielding the maximum possible flame temperature—that required approximating closely to from 1800° to 1900° C. Gas-engines, however, for economical use, do not necessitate such temperatures; the modern development of compression having shown them to be undesirable. It has been proved that an engine using a weak gas can convert as large a proportion of the heat into mechanical work as when a rich gas is used. The gas-engine, in fact, needs a gas which will cost as little as possible per heat unit evolved, and does not require a high flame temperature. All gas-engine makers and designers prefer coal gas for gas-engines. But, says the author, if it cannot be obtained at a sufficiently cheap rate, then producer gas in some form must be used, and when a gas-engine exceeds 50 indicated horse power a producer plant is now generally adopted. He urges that, if gas engineers in changing from high-candle power gas to low-candle power can lower the price for power purposes sufficiently, then a very large increase in gas-engine consumption will follow. He defines large gas engines as those exceeding 100 indicated horse power. The limit has been gradually ascending; and it is difficult to say where it will stop—in all probability, not till gas-engines are built as powerful as the largest steam-engines.

A very considerable part of the paper is devoted to a description of the mammoth gas-engines which the author has recently seen in Germany and Belgium, the builders of which are Messrs. Cockerill, the Deutz Gas-Motoren Fabrik, the Deutsche Kraftgas-Gesellschaft, and Messrs. Körting Bros. All the engines described were found working with blast-furnace gas; and all ignited electrically. In fact, this form of ignition is found best for weak gases. In an analysis of blast-furnace gas, the inflammable constituent is shown to be mainly carbonic oxide, which, being a slow burning gas, is ignited with difficulty by any ordinary igniting device such as an incandescent tube. It would carry this abstract to an inordinate length if only the principal features of some of the huge engines described were brought under notice here. English gas-engine makers have also been hard at work designing larger gas-engines; and firms new to the gas-engine have taken up for English manufacture both the Cockerill and the Körting engines. But in England, the makers have been moving more cautiously than those on the Continent.

The author has himself designed a large gas-engine operating on the Clerk cycle, which will shortly be built. English engineers are quite alive to the necessity of development for the large gas-engine; and they are attending to the matter in what he considers to be an earnest manner, and at not too late a stage of progress. He mentions, in this connection, the names of Messrs. Crossley, the Premier Company, Messrs. Andrew and Co., Messrs. Tangye, and the National Gas-Engine Company. Mr. Clerk only knows of two blast-furnace gas-engines at work in this country—one a Crossley, and the other of the Cockerill type. Quoting from Mr. Booth, he points out that there are from 10 to 12 million tons of fuel burned annually in English and Scotch blast-furnaces; and the blast-furnace gases evolved in this country are sufficient to produce in gas-engines no less than 2½ million horse power over and above the power required for operating the blast-furnace itself. This is an enormous source of cheap power; and the author has no doubt that engineers will speedily be able to employ it for electric lighting and for power distribution purposes. The difficulties which have been encountered in utilizing blast-furnace gas are remarked upon; but the principal one—the presence of dust—appears to have been finally solved by the invention of the centrifugal scrubber. In a reference to Dowson, Mond, and such like gas, the author states his opinion that, even at 2d. per 1000 cubic feet delivered into the works, Mond gas is not sufficiently cheap compared with Dowson gas to give it much, if any, commercial pull. It is interesting to note also that it appears doubtful to him whether the Mond Gas Companies can really deliver their gas to pay at that price. Among others, Messrs. Crossley are putting on the market gas-producing plants which operate with a non-caking bituminous fuel (costing as little as 9s. to 11s. per ton) and supply a gas-engine with clean gas without requiring a gasholder. Such an arrangement, when firmly established, will enable the gas-engine to provide power at less than half the cost of steam power. It is the author's view that, if coal gas giving 600 thermal units per cubic foot can be produced and distributed for about 1s. per 1000 cubic feet, there will be a very large demand indeed both for power and heating; and he thinks it is worth the consideration of gas engineers to see whether a town supply cannot be given on this scale.

The paper was illustrated by several lantern views of the mammoth engines referred to in the paper. Of delightful interest to all the members was the photograph of the most powerful gas-engine station in the world, at Differdengen. In it, there are nine engines of the Cockerill type—three for electric lighting, and six for driving the blowers of the blast-furnaces. The total horse power of the station is 5400; but, as a matter of fact, it can readily develop over 6000-horse power. A view of a large Oechelhaeuser engine, and a picture of the two-cycle engine invented by the author twenty years ago were also objects of curiosity.

Coming to the discussion, Mr. M'Gilchrist was inquisitive as to whether 2d. per 1000 cubic feet for producer gas included all expenses; and Mr. T. O. Paterson wanted information as to whether blue water gas would work gas-engines satisfactorily. In a reference to experiments he made some years ago, Mr. John West states that he found that 5 volumes of Dowson gas about equalled 1 volume of Manchester gas in a Crossley engine. During his recent trip to America, Mr. West saw that rapid advances are being made there with large gas engines, and, in fact, they appear to be supplanting steam in all new work. Natural gas is largely used there; and although it only gives an illuminating power of 8 candles, it has the large thermal heating power of 1000 units. What gas managers should aim at, in his opinion, is a gas of 10 or 11 candles, and cheap in price, so that it can be used for all purposes. The relative efficiency of gas-engines with producer and coal gas was referred to by Mr. Isaac Carr. He put his contention in this way: If a man has an engine which will give him 100-horse power with coal gas, with producer gas the effective power developed will fall to 75 or 80; or, put in another way, an engine can be purchased to exert the duty required at 20 per cent. less cost than would have to be paid for an engine to get the same power with producer gas. As to Mond gas, the real calorific value is only 125 units; and therefore, instead of the ratio being as 4 or 5 of Mond gas to 1 of coal gas, it is 6 to 1. This, of course, has an important effect upon the relative price of the two gases. Another point made by Mr. Carr is that to make a gas of high calorific power means a considerable sacrifice of ammonia yielded; and, as, for commercial success, these Mond Companies are going to largely depend upon the yield of ammonia, there will be a great temptation to impoverish the gas in order to get a revenue. He explained that, in order to make good gas, it is necessary to increase the temperature, which means the dispelling of a greater quantity of nitrogen, and hence the production of ammonia. He thinks no great danger is likely to arise from the competition with Mond gas. Another interesting matter is that Mr. Carr is now supplying gas at 1s. 1d. per 1000 cubic feet for motive power purposes. The question was put by Mr. C. Elliott (Leyland) as to how gas at 1s. and of 600 thermal units would compare with steam power. He supplies 17½-candle gas at 3s.; and this has a thermal efficiency of about 700 units. People who use gas-engines tell him it is several times dearer than steam; and if this is correct, gas at 1s. will hardly be as cheap as steam. Going seriatim over the speakers, Mr. Dugald Clerk stated that the 2d. per 1000 cubic feet for producer gas includes everything, without distribution cost; and this, he thinks, is a matter the Mond people seem to have forgotten. Blue water gas is worked in gas-engines; but with this gas the number of heat units only runs to about 300, which is exactly double that of Dowson gas. But, on the other hand, blue water gas is much more expensive than Dowson gas; and the same economy cannot be got with it as when using weaker gas. With coal gas at 1s., he is certain the field will be considerably extended for motive power; and even if coal gas engineers cannot get down to what the steam-engine is doing, the convenience, uniformity, and certainty are great points in their favour. The whole thing, however, turns on the question of cost. He informed Mr. West that he is right in his calculation as to 1 cubic foot of Manchester gas being about equal to 5 cubic feet of Dowson gas. Mr. Clerk does not think America is ahead of us in this matter of gas-engines. The Continent is a little; but he is of opinion that they will not occupy the position long.

Incandescent Burner Maintenance and the Fittings Business as an Aid to the Sale of Gas.

The two papers which succeeded, and which filled up the remainder of Tuesday's sitting, were on subjects of current importance in connection with the commercial side of the gas industry, and so both were apposite for discussion at the present time—if only to get the proposals advocated in them more widely disseminated and known.

The first was by Mr. Norton H. Humphrys; and it was on the "Maintenance of Incandescent Gas-Burners by Gas Companies." If one might make a little suggestion here, it would be well if writers of papers, in dealing with a topic of general applicability, would be careful to use general terms. As an example, the use of the word "companies" here may be regarded by some as savouring of a little invidiousness. The same thing occurs in places in Mr. Watson's paper; and in both contributions "undertakings" or "suppliers" would have been preferable in an assembly composed of engineers and managers of both corporation and company undertakings, seeing that to both the subjects are of equal importance. However, the point is not one of great moment; but there are susceptible people even in the gas industry. But turning to the paper, it was only put forward as an opening to the discussion of the matter. Mr. Humphrys did not—and rightly—regard it as necessary to enter into any detailed explanation of the system, or to enlarge upon the desirability of gas companies undertaking the work. He devoted himself to a plain account of experiences at Salisbury, where incandescent lighting is represented by 600 public lamps, 200 outside shop lights, and some 2000 interior burners. The author applies to maintenance the excellent axiom that, if it is worth doing at all, it is worth doing well; and he deprecates running it as a stop-gap in connection with existing duties. If the scale of operations permits, the system should constitute a distinct branch, and be in charge of men who devote their whole time to the work, and to canvassing and disseminating information as to the various uses of gas as an accompanying duty. Mr. Humphrys does not look kindly on partial maintenance, and he directs his attention entirely to inclusive maintenance, though he is prepared to take on partial maintenance or anything else that will tend to retain and consolidate business. The Salisbury Gas Company have succeeded in getting the whole of the public lighting in their district on the incandescent and all-the-year-round systems. The method of maintaining the public lamps first adopted has

worked so satisfactorily that it has been continued. The lamplighters report defects; and the defects are entered on a complaint-sheet arranged with a column for each man. The sheet is handed to the outdoor foreman; and the maintenance men (who are present at the hour when the lamplighters are due) proceed at once to remedy the defects, commencing with the most important thoroughfares. By the end of 1898, 500 lanterns were fully established; and customers soon began to notice the lights, and compare them with their own—which is a tribute to the argument recently advanced in these columns as to the powerful influence as an advertising medium of lamps in the public streets. Commencement was next made with the supply of outside shop lamps on three years' hire purchase terms, with an additional charge for maintenance, and then followed isolated cases of indoor lighting, such as places of public worship and public rooms. A year's experience, and the Company felt safe to undertake any kind of work; and their efforts have been accepted with cordiality, and have given general satisfaction. Maintenance work is not undertaken for less than a year; and it is understood that the terms cover the whole of the burners on the premises. The Company's undertaking includes the keeping of glasses clean, the burners in good order, the renewal of mantles, rods, and plain glass cylinders, but no fancy glass or other parts of burners. A separate account is kept for each lamp or customer. The department is not a direct source of profit; but it is not an important expense or source of loss. The indirect advantages, Mr. Humphrys says, leave no question as to the desirability of adopting the system; and this is the general experience.

It is still a moot point with many directing gas undertakings as to whether it is advisable for them to break through the old bonds of conservatism, and depart from their established practice of acting only as suppliers of gas and of gas consuming apparatus. Those who have had the courage to take the step have not regretted their choice; and among them is Mr. Robert Watson, of Hertford, who, in the next paper, put before the members a well reasoned argument in favour of a more systematic development of a district gas-fitting business as a useful aid in increasing the output of gas. The slot-meter business and the maintenance of incandescent gas-burners are working to this end; and Mr. Watson is strong in his belief that any enterprise which brings about direct connection between gas suppliers and consumers should be encouraged for all it is worth. He considers that his slot customers at Hertford (numbering nearly one-third of the whole) are far better lighted and served than the average ordinary gas consumer; and this obviously results from the close touch existing between the gas suppliers and the customers, and the Company's control of everything from the main to the burner. The same result is attained by the incursion of the Company into the business of incandescent burner maintenance. In short, he holds that the establishment of a good district fittings business is indeed a necessity, if efficiency and general satisfaction in the use of gas are to be ensured, and further progress made in its popularization. The value of such a business as a channel for offering advice, for the opportunity it gives the consumer for lodging verbal complaints, and for the possibilities it confers for propaganda enterprise, are dwelt upon. He commends advertising at not too infrequent intervals, and he values highly the keeping of the various enterprises of gas suppliers in evidence before the public as far as possible. The progress of the Hertford Company during the past five or six years is encouraging to the adoption of the author's methods. The increase in the sale of gas has been about 50 per cent.; and this with the small gain of only 3 per cent. in the population during the last decade. Some two-thirds of the names of the consumers are now to be found on the books of the fittings business; and during the period named, the ratio of cooking-stoves to consumers has improved from 1 in 18 to 1 in 3. The author does not hold out any hope as to a fittings business being made into a direct profit-bearing concern—in fact, he rather deprecates it being entered upon with that view. But he regards it as a centre for the development of the gas business; and that development brings profit in its train. The actual profit on the business in Hertford—debiting it with a fair proportion of the charges for rent, rates, taxes, insurance, salaries, light, interest on capital, &c.—barely pays for supervision. But it helps in the maintenance of the town office. The advent of cheaper mantles will, the author believes, afford a welcome stimulus to the fitting enterprise in incandescent lighting. Towards the close of the paper, he advocates the wider application of the principle involved in the slot-meter and hire-purchase methods, by working for consumers and spreading the cost over a number of quarters. It is impossible, says the author—speaking from experience—to work a gas-fittings business without being conscious that it has a definite value to the gas undertaking concerned.

In a few side remarks by Mr. Watson, he mentioned that the paper was written before the lowering of the prices of Welsbach mantles; but he regards the reduction of 1½d. in the retail price of these mantles as very small, and is afraid it will not help gas managers much. In his opinion, 9d. is not a penny too much to cover inclusive maintenance; whereas, under the partial system, the 3d. or 4d. seems to him to be a fair charge for the labour involved. It may be pointed out that, in speaking of the small reduction in the price of Welsbach mantles, Mr. Watson omitted to mention the several other sources from which cheaper mantles can be obtained, under the Welsbach licence, and which will make a considerable difference in connection with this maintenance question.

The first speaker in the discussion was Mr. S. Y. Shoubridge; and, in the case of the Crystal Palace Gas Company, he does not find the complication referred to by Mr. Humphrys in connection with the adoption of the partial maintenance system. It saves the Company the risk of loss that there may be under the other system. He also mentioned that the Welsbach Company have abandoned the inclusive maintenance system altogether, having found it involved great loss. (Mr. Shoubridge will pardon the pointing out of the fact that the Welsbach Company gave much more in the way of attention and labour than most gas companies are giving for the inclusive charge—their men, we believe, paid a weekly visit to the houses of the maintenance customers.) Mr. Shoubridge also agrees that the time has arrived when gas suppliers should go out a great deal more than they have done to seek for business. He is working now to get churches and chapels to adopt incandescent lighting, and his advances are being received with great readiness. He believes in obtaining a good foothold before the electric light people come in. One thing that struck Mr. John West very forcibly when he went to the States was the way that our American cousins look after business and haul it in. He instanced the Milwaukee Gas Company, who buy gas-stoves by the thousand, hand over to plumbers and gas-fitters a stock, and get them to sell them for a percentage of profit—the stoves being fixed up free. It was pointed out by Mr. Whatmough that Mr. Humphrys stated that his increase in gas consumption is being well maintained at 5 to 6 per cent. annually; but yet he mentions that a great economy has been effected in the public lighting by the introduction of incandescent burners. Mr. Whatmough was therefore curious to know from whence came the increase. Interesting experience was related by Mr. Titley as to the effectual assistance the incandescent gas-burner and maintenance system have rendered at Guildford in keeping at bay the electric light. Mr. Davey has gone considerably farther at Newbury than most gas managers, by fitting up his slot-meter consumers with incandescent burners. This has been done for the past two-and-a-half years, and it has given very great satisfaction. Mr. F. W. Cross also gives one incandescent burner, mantle, and chimney under his slot system and he finds this leads to the purchase of additional burners. When Mr. Riley went to St. Austell six years ago, electricity held the field; but through taking up the fittings business and pushing gas, they have won back the whole of the consumers who had turned to electric light. It is interesting to note how the electric light people got the consumers away in the first place. They visited them, asked for their gas bills, and then offered to supply the same number of electric lights at 10 per cent. less. Since Mr. Riley's advent, the Gas Company's increase has been 80 per cent.; the Electric Light Company have been in liquidation for the past three years. Mr. Cornish has had a rather lengthened experience of incandescent maintenance at Bridport; and, for indoor lighting, his average consumption of mantles has only been one-and-a-half per annum. Small wonder then that his 9d. per burner per quarter pays "fairly well." He also disagreed with Mr. Humphrys that partial maintenance introduces complications.

At this point, the discussion was adjourned, and was resumed the following morning after the lecture. It will, however, be convenient to here complete the epitome of the

other speakers' remarks. Mr. W. W. Hutchinson, who is ever seeking information, and who has a happy knack of putting his inquiries in a terse way, asked for experience regarding the lighting of incandescent burners in churches or chapels—whether pilot lights or torches were the best for the purpose. Mr. J. H. Troughton has fitted up three churches with Nos. 3 and 4 Kern burners. In one case, the lighting bill was reduced last quarter from £6 to £1 12s.; but the amount of light was more than doubled. In Newmarket, the public lighting is exclusively by incandescent gas-burners; and his expenditure of mantles averages four per annum. Wakefield Cathedral, Mr. Townsend informed the meeting, has lately been fitted with incandescent burners; and they are lighted exclusively by torches. He has introduced the maintenance system; and has had one or two unexpected experiences. He finds some careful people still look after their own mantles, while the careless ones give a good deal of trouble, and in certain cases have been very expensive. But by exercising the art of polite but direct and pointed letter writing, he has succeeded in righting matters. Now that he has made his public lamps windproof, 3¾ mantles per year is his average usage. It will be remembered that Mr. D. Lyne, of Wexford, presented a useful paper at the Belfast meeting in the early nineties on the supply and maintenance of fittings; and consequently he takes a great deal of interest in Mr. Watson's paper. To the author's recommendations of the adoption of the fittings business, he added the opportunity it offers for the control of the size of pipes; and the advice which can be given as to good and satisfactory pendants. At Tunbridge Wells, Mr. Dougall has encountered great opposition from the electric light. The builders in the town appeared to favour it; but he has had no difficulty in getting them to agree to have their houses fitted with gas-piping as well as wiring them for electricity. The result of a year's working of the maintenance system there is that his Company have now 1500 burners under their care. They charge 9d. per burner; and, in the past nine months, they have made a loss of £10. This they do not mind, as they take the view that it is much better to give attention to the consumer than to make a small reduction in the price of gas. They do not stop at maintenance; but have adopted a similar system in connection with cooking stoves and fires. According to Alderman Miles, the Bolton Gas Department has had 25 years' experience of the fittings business; and it has been a source of profit. They have made as much as nearly £1000 in a year out of it; and it has been of inestimable value in satisfying the consumers. He is also of opinion that it behoves gas managers to take up the maintenance question vigorously. Mr. Langford finds the bye-pass an intolerable nuisance in public lamps. At Formby, Mr. Buckley has 128 street-lamps on the incandescent system; and his average renewal of mantles works out to six per annum.

This ended a very long discussion; and then the President called upon Mr. Humphrys and Mr. Watson to reply. The former gentleman mentioned that four-fifths of the places of worship in Salisbury are on the incandescent maintenance system; and the installations have been the means of attracting considerable attention. He does not aim at getting a record low consumption of mantles, preferring to keep the public lamps in good condition for the sake of the advertisement. He is of opinion that there is more to be done in pushing business in the future than has been done in the past. The greater part of the increased consumption in Salisbury is due entirely to new business. In his reply, Mr. Watson stated his preference for selling goods himself rather than enter into co-operation with plumbers and gas-fitters. As to adopting incandescent burners in connection with the slot system, in his case, the average slot consumers are poor, and the cost of renewals would make them think very seriously before they became consumers of gas. If he went in for supplying them with incandescent burners, he should strongly recommend that the maintenance should be done at the Company's expense.

The Electrolysis of Gas-Mains.

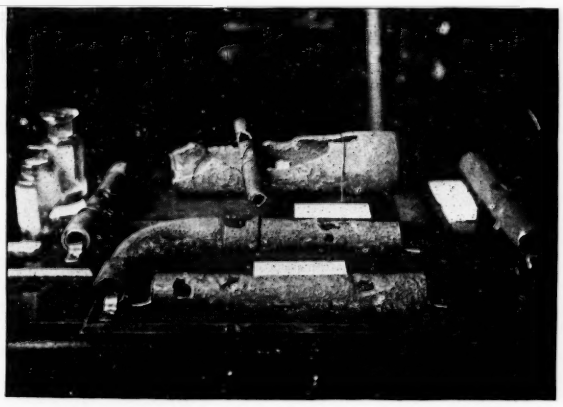
Wednesday morning opened with a very enlightening lecture on the above subject by Mr. James Swinburne, the President of the Institution of Electrical Engineers. Mr. Swinburne had his lecture in writing; but he ignored the prepared version, and spoke freely without it. Certainly, with all deference, we incline to the opinion that the oral effort was to be preferred to the set composition. It was apparent that the lecturer had not before him a particularly easy task in speaking as an electrician to gas men on a subject in which electricity is the accused transgressor. However, the lecturer went fully into the question, imparted much general information, and was undoubtedly moderate and fairly impartial; but withal he had little to offer which can be accounted as comforting to the gas man in his solicitude for the property under his care. The first part of the lecture was a brief narrative of the history of the question; but, when he came to attack the subject proper, he remarked that "the greatest difficulty is to give any real information as to the true effect of the earth currents from tramways. The question from the technical or scientific side is very obscure." (Parenthetically it may be remarked that it is a little difficult to know precisely the meaning which the lecturer attaches to the words "true effect;" for later on he showed a very intimate acquaintance of cause and effect in relation to this particular subject.) He proceeded to explain to his hearers how it is that a gas-pipe can only be corroded where it is acting as an anode—that is to say, when the electric current is leaving it to pass into damp ground. There is no corrosion where the electricity enters the pipe, because it is a cathode there, and there is no corrosion where the electricity leaves, unless it passes into an electrolyte such as damp earth. If, he said, the electricity is taken off by a metallic conductor, such as a wire, which is not an electrolyte, there is no corrosion. He considered next the electrical connections on a tramway overhead wire system; making it clear that any current that leaks away from the rails (and he admits that there is a considerable amount of straying) must either find its way back into the rails, or otherwise return to the generator. The earth acts as a bye-pass to the electric current, and the gas-pipe as a sort of second bye-pass. Where it enters into the pipe the electricity does no harm; but where it leaves it, there is corrosion, unless the pipe is connected by means of a wire to the return or negative end of the generator circuit. For the information of those who have not studied the question, he introduced an explanation of the relations of the electrical quantities that have to be dealt with. A consideration of the precautions and measures taken to minimize corrosion of pipes succeeded. The first thing is to keep the resistance of the return rails as low as possible. The rail-joints are therefore bonded, or electrically joined, by bonds of flexible copper. But in a long line, or where the traffic, and therefore the return current, is large, no amount of bonding will do. The Board of Trade here steps in with a regulation that a tramway must not spend more than 7 volts on its return rails. Insulated conductors, known as "suckers," are therefore introduced at various points of the system; and these have what are called "negative boosters" in their circuits, which subtract or suck away the pressure. To prevent leakage from the rails, they are insulated to some extent by being embedded in concrete; but the lecturer confessed that this concrete when wet conducts well. Sometimes, instead of suckers, the flow of electricity is helped along the rails, as it were, by "helpers," or boosters, arranged in the rail circuits. Further information was supplied as to the Board of Trade regulations.

Little or nothing more, Mr. Swinburne acknowledged, can be done to protect the pipes by dealing with the return-rail track. Something, however, can be done to the pipes. If all parts of the pipe that might act as an anode are connected by wires to the rails, or to the station, so that the electricity can be carried off without passing into an electrolyte, there is, he said, no electrolysis, and the pipes are safe. The region round the station is clearly that where the pipes may be anodes; and if metallic connection is made from the negative terminal of the station to the pipes in the danger area, the pipes are safe. This increases the current in the pipes; but that does not matter to the pipes unless there are joints which cause the electricity to pass round by the earth. Again, when suckers are used, they are arranged so that they reduce the pressure of the rails where they join below the earth, so that the rails are then negative to the earth. They therefore make local danger areas. The pipes should thus, where possible, be also connected to the rails there. Another cure, he stated, is to have both electrical conductors overhead; but the method is so inconvenient, so costly, and so unsightly, that it is almost out of the question. He also suggested that there is a further system that has not received the attention it deserves, and that is the three-wire system; but it appears to be somewhat complicated and to possess certain difficulties.

Proceeding to consider further what the gas and water

companies can do to protect their pipes, he pointed out that wrought-iron pipes are more quickly corroded than cast. In addition to metallic connection with the power house or the suckers, he suggests that it would be an advantage to destroy the electrical continuity of pipes by occasionally packing joints with sulphur, sulphide of iron, or something other than lead. The insulation of occasional joints in water-pipes, he also stated definitely in a sentence, would be of advantage; but from what followed, it appears to be a rather doubtful expedient.

In discussing the question as to how much damage electrical tramways are doing now and how much they will do in the future, it is clear that Mr. Swinburne does not regard the experience in America as being any criterion on which an answer may be based, in view of the fact that the early tramway systems there were very badly constructed. Another point which the lecturer made was that any stray current that gets into pipes must have left the rails, and so must have corroded them proportionately. But the current in the pipe is generally only a very small fraction of the whole stray current; so that, if there is corrosion in the pipes, there must be a very much greater corrosion of the tramway rails. In their own interests, therefore, electrical engineers must keep the stray currents down as low as they possibly can. This is true. But Mr. Swinburne spoke as though he considered that, as the tramway rails may be corroded to a greater extent than the pipes, the tramway people were entitled to a greater amount of sympathy; but he ignored altogether the fact that not only are the innocent previous occupiers of the soil being damaged by the new-comer, but in their case they stand a good chance of further trouble through considerable



The President's "Ghastly" Samples of Electrically Affected Gas-Pipes.

damage being occasioned by explosion. However much a tram-rail is corroded, it contains nothing that can cause any greater disaster. The "best thing," in the lecturer's opinion, for gas and water undertakings to do is to watch their pipes carefully, and to inspect them whenever they are open for other purposes. When a pipe is uncovered, it would, he also says, be well to measure the electric current in it. But a minute later, he referred to another "best thing" for pipe companies to do, if they cannot get legal protection, and that is to make friends with the tramway people. To make electrical tests involves some electrical knowledge; and if the tramway people and the gas and water undertakings work together, the former would, Mr. Swinburne thinks, make the tests for the latter without any great difficulty. It is also clear that the lecturer cannot advise Parliament as to what is the right course for them to take; and while it is obviously fair to make the tramway people liable for any damage they do, he sees very serious difficulty in carrying into effect protective clauses.

By means of a lantern and fitted slides, to which latter was connected an electric battery, Mr. Swinburne was able to give to the members a very clever representation of the effects of electrolytic action—showing, among other things, the action which ensues when a pipe is an anode, and the harmless effect when it is a cathode. He also referred to some "ghastly" specimens of affected pipes, which the President had unkindly arranged to be present, and which were taken from the streets of Southampton. But, in a reference to them, he mentioned that there is a good deal of confusion between fusion and electrolysis. Fusion is generally caused by pipes falling foul of electric light mains, and has nothing to do with electrolysis at all; while electrolysis is more likely to be caused by electric tramways. It would have been interesting if Mr. Swinburne had shown why gas and water companies should bear the expense of carrying out the protective measures he suggested for their pipes, and not the tramway people.

The lecturer was very heartily thanked for his lucid exposition and demonstration, which, with all its shortcomings, was, as we said at the beginning of this sketch, both enlightening and entertaining.

The concluding part of the discussion was then taken on the subjects of incandescent burner maintenance and the gas-fittings business; and following this, the President called upon Mr. W. D. Child for his paper on

The Application of Steam-Turbines to Blowing and Exhausting Apparatus.

This is a contribution upon which the water-gas maker both present and future will set high value. It tells of the adoption, in the author's carburetted water-gas plant at the Romford Gas-Works of De Laval steam-turbines, in place of steam-engines in connection with the blowers. It seems to us to be rather a fortunate circumstance than otherwise that some doubt arose as to whether the floors and a wall of an old building which forms one side of the engine-room would withstand the vibration set up by reciprocating engines when driving belting, pulleys, and counter-shafting running at the high speed required with blowing plant, as to this circumstance we owe this interesting application of the steam-turbine. The large volumes of air at high pressure required in carburetted water-gas manufacture necessitates the use of centrifugal fans for obtaining the pressure. In the usual practice, a peripheral velocity of the fans of about 17,000 feet per minute is needed, which means with fans of practicable dimensions a speed of 1500 to 3000 revolutions per minute. Mr. Child wrote as one who felt himself on pretty safe ground when he spoke of the disadvantages of steam-engines, and the usual requirement of belt gearing and frequently counter-shafting, for the purpose of allowing the rapidity of motion necessary for the fans. In thinking over these disadvantages when laying his plans for the water-gas plant, Mr. Child remembered some high-speed expansive rotary engines that he saw at the Crystal Palace in 1893, and the recollection was accompanied by regret that this type of engine had not been more fully developed and utilized. He mentioned the matter to the water-gas plant Contractors—Messrs. Humphreys and Glasgow—and they offered to substitute for the engines steam-turbines—the result being that the De Laval type was selected. This introduces into the Romford installation a novel feature, which has proved satisfactory, and is apparently possessed of many advantages.

The author devotes a considerable part of his paper to a description of the construction and action of the turbine as compared with the steam-engines ordinarily in use. In its most recent form, the De Laval steam-turbine is characterized by the simplicity of its construction and the directness of its energy conversion. Its principle is to take up the kinetic energy of a steam-jet in the buckets of a turbine wheel, against which the steam is blown, thereby imparting a rotary motion, and delivering most of its energy to the rotary wheel. The steam acts by its speed and mass; and, before entering the buckets, it has already been converted to the same pressure as exists in the chamber in which the wheel rotates. To accomplish this, the high-pressure steam, after passing through a governor, enters the steam-chamber, where it is distributed to steam-nozzles. These are fitted with shut-off valves, by means of which one or more nozzles may be cut out when the turbine is not loaded to its full capacity. The high speed of the steam is obtained by expanding it; and this expansion takes place in the diverging nozzles, the passages of which are made conical. The steam, having been completely expanded, is blown through the buckets; and its kinetic energy is transferred to the wheel. With steam at 120 lbs. pressure per square inch, the velocity of the outflow steam would be 2822 feet per second, giving a theoretical peripheral speed exceeding 1200 feet per second. The actual speeds adopted are shown in tabular form in the paper; but here it is sufficient to state that the figures given for a 5-horse power turbine are no less than 30,000 revolutions per minute, and a peripheral speed of

515 feet per second. The bold and ingenious idea of De Laval in adopting a flexible shaft to this steam-turbine is described by the author as one of the most striking and remarkable inventions in steam engineering. Among other noteworthy features, he draws attention to the fact that, although high-pressure steam is admitted to the turbine case, no stuffing-box or gland is requisite to retain the steam. He then describes the small but extremely sensitive governor employed to regulate the high speed of the turbine. But leaving descriptive matter, the author supplies an idea of the general efficiency and cost of running from an average of a number of tests made at Romford. With a turbine of 15-brake horse power, at 25,000 revolutions per minute, running with three nozzles open, and with a boiler pressure of 120 lbs. per square inch, the consumption of steam was 34·45 lbs. per 1000 cubic feet of gas made. The steam consumption of a high-speed reciprocating engine, working with belt gearing on to the blower, was, under similar conditions, 52·35 lbs. per 1000 cubic feet. The small space occupied by these machines, as well as the readiness with which they are erected, are points of great importance. The turbines at Romford are in charge of an intelligent labourer who has been trained in gas-making; and the attention they have required during the months they have been running has been so little as not to be worth mentioning.

There was a very fair discussion, considering that the paper was on a subject which may be regarded as new for the members. Mr. F. W. Cross, who has seen the turbines at Romford, asked Mr. Child whether, when he cuts out one or more of the nozzles when the turbine is not loaded to its full capacity, it runs at a lower speed, and whether at the lower speed there is a lower pressure of air. The pressure of the air should certainly be under control, so to increase or decrease it as desired. He also wished to be informed as to the action of wet steam as compared with dry steam on the buckets. Mr. Child mentions 120 lbs. pressure in his paper; and Mr. Cross was inquisitive as to whether this high pressure is used primarily for working the turbine, or for working the gas apparatus. He wondered whether it could not be reduced to 100 lbs., if 100 lbs. would be economically sufficient for the generator. Alderman Miles seemed somewhat alarmed at the high speed of 25,000 revolutions per minute referred to by Mr. Child; and he inquired as to the prospects of wear and tear. He is afraid it will be rather heavy. Mr. J. P. Leather was anxious for definite information as to the consumption of steam per horse power. From some rough calculations, he thought it worked out to 3 or 4 lbs. of coal per horse power, and some 60 to 80 lbs. of steam per horse power. He also expressed a desire to know how a 15 or 20 brake horse power engine would compare with a similar brake horse power steam-turbine. Mr. S. O. Stephenson (Tipton) feels doubtful as to the application of this steam-turbine for exhausting work, seeing that exhausters are run at slow speeds. The cost of the turbine as compared with the steam-engine is a point on which Mr. W. W. Hutchinson sought particulars, and another question was as to whether 120 lbs. pressure was really necessary to make a success of the turbine. In answering his interrogators, Mr. Child stated that the machine is readily adapted to the requirements of the work it has to do. The amount of pressure at which the blast has to be raised is determined, and then the machine has only to be set to obtain it. In his opinion, it is better to cut off one or two nozzles completely than to have to partly close the whole lot. Wet steam would be prejudicial to the turbine wheel; and it would have a bad effect on the buckets. He explained that he uses a pressure a little over 100 lbs.; the reason he mentioned 120 lbs. in the paper being that that is the pressure at which the safety-valves are set to blow off. As to the wear and tear, he is well satisfied that there is nothing to fear in this respect; and, regarding the question of cost, the contractors simply supplied these turbines instead of the engines contracted for, so that he could not speak definitely. The point as to the use of the turbines for exhauster work was only a suggestion on his part; but he thinks the speed could be reduced sufficiently for exhauster purposes by gearing. He is of opinion that exhausters are not run at sufficiently high speed. This contribution was, on all hands, admitted to be of the greatest technical interest.

The Day of Rest.

The sitting had already extended from 10 o'clock to about 1.15; and, consequently there was a large exodus of members as Mr. R. G. Shadbolt stepped forward as the defender and promoter of the cause of Sunday rest among gas workers. His paper on the subject maintained his reputation as a vivid debater; and it brought out once more his power of compassing a topic from all points. He spent little time on the general question; Sunday rest being a law long since settled and accepted. The at one time almost general violation of the law in gas-works, he shows to be slowly but surely passing away; but, unfortunately, there are still a considerable number of works the managements of which adhere to the same old arguments which were opposed years ago to the cessation of Sunday labour—arguments which have been undergoing the process of trituration by the progress of the observation of the Sabbath as a day of rest in other works. Those arguments, later in the paper, Mr. Shadbolt pummels in such a dispassionate manner that offence cannot be taken. In 1900, it will be remembered, the author of the paper made a very interesting contribution to the proceedings of the Manchester District Institution of Gas Engineers on the subject of "The Minimizing of Sunday Labour." He was induced to pursue his inquiries; and, as a result, he circularized no less than 1600 gas undertakings in the United Kingdom.

Numerically, the replies received were not encouraging. They only amount to 443, representing 438 undertakings; but scrutiny reveals the fact that they represent 106,000 million cubic feet of gas, out of a total annual make of some 159,000 millions in the United Kingdom, or a percentage of over 67. Of the 438 undertakings, 218 stop gas making on some portion of Sunday, and 220 do not. Yet investigation discloses this satisfactory point, that the works stopping on Sunday represent an annual make of 83,310 million cubic feet; being 78·14 per cent. of the total output of undertakings making returns, or 52·39 per cent. of the total output of the United Kingdom. Fairly, then, the author assumes that there are 50 per cent. of the gas stokers of the United Kingdom who enjoy a certain amount of rest on the Sabbath; but an equal percentage who are debarred that privilege—whether or not they regard it as such. This fact alone justifies the keeping of the subject to the front. The author dispels the notion which seems to have found place in the minds of some gas managers that the present inquiry is the forerunner of an effort to make Sunday stops compulsory. Public opinion and force of circumstances will in time effect the necessary cure, without going to the length of legislation. (In passing, the author gives to the father of Mr. William King, of Liverpool, the honour of having been the first to introduce a cessation of work for eight hours on Sunday. It was in the year 1843, or possibly earlier, that Mr. Alfred King started the eight-hour shift at Liverpool, and the eight-hour stop on Sunday.) The paper includes statistics as to the years that Sunday stops have been in vogue in a number of works, information as to the reasons of stopping other than all the year round, and the duration of stops. It appears that twelve hours is the duration in more than half the works practising Sunday stops; eight hours make a poor second; and a variation between twelve and six hours takes the third place.

The paper will be valuable and helpful to the progress of the cause; and it will be an incentive to those who are bordering on a change to hasten it on. It is, to say the least, cheering to find there are quite a number who are on the point of inaugurating Sunday stops; others thinking of so doing; and some only awaiting the completion of new and more suitable plant to bring about the change. The future of the movement is bright, when we find that Mr. Shadbolt has ascertained, from his returns, that of the undertakings in which Sunday rest has not been adopted, there are 181 in favour of Sunday stops, and only 11 unfavourable. He makes an extended examination of some of the reasons for not suspending carbonizing on Sunday. Most of them are as old as is the question in its application to gas-works. The three most prominent reasons—taking the number of undertakings advancing them—are insufficient storage, defective or unsuitable plant, and extra pay for Sunday work. Out of the mouths of those who have stayed manufacture on Sunday, Mr. Shadbolt disproves the validity of most of the reasons offered. Very few advance monetary excuses for not effecting a change; but there are a few, and some of their reasons are curious. In his Manchester Institution paper, the author estimated the actual loss entailed by stopping and restarting at £1 7s. 10d. per million cubic feet of gas made; but, meanwhile, he has had an agreeable surprise, as he has ascertained that, during the three years

that Sunday stops have been in operation at his works, the carbonizing wages have diminished from £9 13s. 8d. per million cubic feet to £8 5s. 6d.—due entirely to better work, attributed largely to the beneficial effects of Sunday rest. Mr. Shadbolt has collected a diversity of views during his inquiry on the subject; but the manager who described the provision of rest for stokers on Sunday in the monosyllabic phrase—"a plain duty"—has summed up the whole matter. Many points of importance in the paper are not mentioned here; but, in ending this account of the salient features of the contribution, it may be said that Mr. Shadbolt has indeed been successful in performing work of a most useful character in an excellent cause. Herein he certainly has an abundant reward.

The discussion was postponed to the following morning, when, at the commencement, there was rather a thin attendance; but those who were present took a really keen interest in the subject. Mr. John West—a leader in all pertaining to the amelioration of the conditions of gas workers—opened with an enthusiastic speech. His memory carried him back to the year 1870, when the subject was, probably for the first time, brought before the members. A similar set of questions to those circulated by Mr. Shadbolt was then sent out; and the answers received were also similar. Some gas managers were then convinced that there were no difficulties in the way of reducing Sunday labour, and started to do it. He recounted his experiences at Maidstone, and subsequently at Manchester. At Maidstone, there were at first fears as to the outcome from the Company's point of view; but the result was better the year after the Sunday rest was introduced than before. It is, said Mr. West with emphasis, a moral obligation devolving upon every gas manager to give his men a day of rest, if possible. For four or five years, Mr. John Carter has stopped twelve hours on Sunday for about ten months of the year. He, however, fails to see how Mr. Shadbolt makes a profit out of the change; and he does not think it is a subject in which £ *s. d.* is the proper factor to take into consideration. His experience is that the first shift of the week, after the stop, is the one in which the carbonizing results are the least satisfactory. He is bound to say that his men would rather have a day off at ordinary pay than come in and get day-and-a-half pay. He is of opinion that gas-works ought to be able to keep going with thirteen-and-a-half shifts a week instead of fourteen. Mr. T. H. Martin, working twelve-hour shifts, stops for twelve hours every Sunday; and he never finds any bad results in the first shift following the stop. Mr. Isaac Carr claims to make gas "fairly economically;" but he has not introduced Sunday stops. He leaves it in a measure to the men themselves. Where twelve-hour shifts are worked, he thinks this calls for some consideration; but, in his view, it is rather a different matter where the men work eight-hour shifts, and have the third Sunday off. Speaking from his experience at Pontypridd, Mr. Jones is also of opinion that, with the eight-hour shift, Sunday stops are not necessary, seeing that the men have a full sixteen hours rest. His view is that in many cases, the men simply treat the Sunday as a holiday, and indulge in "recreation" of a most disagreeable kind. Mr. J. A. Harris looks at the matter as one of personal responsibility to every gas manager. To the question, "Do the men need rest?" he can only find one answer. If a rest on the Sabbath is good for himself, then why, he asks, should it not be for his men. Mr. C. S. Ellery expressed sorrow that they had just heard such views from Wales as Mr. Jones had expressed. He himself has had twenty-two years of Sunday closing; and his returns on Monday morning are invariably better than those for other days of the week. With confidence, he advises all who are hesitating to adopt the system of Sunday rest for the men. In his case, there is a cessation of work for sixteen hours during eight or nine months of the year. The men leave at five in the morning, and recommence at ten o'clock at night. Mr. H. Townsend finds that he can stop as easily with inclines as with horizontals. All he does is to partially close the chimney dampers, and not touch either the primary or secondary air-slides, or the bench dampers. He confesses that more work is placed on the manager; but few, he is sure, will begrudge that little amount of extra labour when it confers so much on the men. His men appreciate the day off more than the day-and-a-half pay. Mr. Robert Porter has also partially stopped on Sunday for six months with inclined retorts. For 25 years the President has worked the eight-hour system; and, under that system, a stoker, he says, gets more physical rest than under the twelve-hour shift. In his case, two gangs on Sunday go in for a few hours; so that he carries out a portion of the principle advocated by the author. For the time the men are off, they are paid. Mr. Shadbolt, in his reply, was not at all surprised there should be divergencies of opinion, seeing the conditions are so changeful under which gas managers labour. In his view, any small loss there may be is more than counterbalanced by the advantages gained. Because men are against stops in certain instances, that, he fairly points out, is no argument against Sunday stops; it proves nothing but the demoralizing effect of the old methods of working. The experiences given as to stopping with inclines, he regards as exceptionally interesting. In this matter, he believes that all will in time have to bow to public opinion.

The Valuation of Gas Oils.

On all sides, it was acknowledged that the paper Mr. John P. Leather, of Burnley, next contributed (on the subject of the valuation of gas oils) is an especially useful one. There is undoubtedly, with the growth of carburetted water-gas manufacture, room for a considerable increase in the knowledge we possess of the properties required of a gas oil, and how these are to be determined. The author proves this from his own experience and experiment. When, a few years since, he contemplated the erection of a carburetted water-gas plant, he understood that there was practically no great difference between one petroleum oil and another—provided, of course, the oil used was that burning between certain customary limits. After the erection of the plant, very good results were obtained from Russian "solar" distillate; but cheaper Borneo oil the next season gave very poor results. This led to an examination, in conjunction with Mr. Raymond Ross, F.I.C., which disclosed very important differences in the chemical composition of the oil, as compared with that previously used; and following this up, the author and Mr. Ross made as complete an investigation as was possible into the constitution of the various gas oils on the market. Briefly as he was able to do, Mr. Leather, in the first place, set forth the constitution of the different classes of hydrocarbons found in pretroleum. He divided them into the open-chain and the closed chain compounds; and in the discussion by him of these two classes, will be found some very instructive matter. It is seen that the value of a gas oil is practically proportioned to the percentage of paraffins and olefines present; the benzenes and naphthenes being of no value, except as tar. The analysis of an oil to determine what percentage of these compounds it contains, is not very simple; but the author sketches the lines on which an oil may be examined, and then gives a concrete instance of the method of deduction to be employed. Five different oils were taken; and the general characters of the oils are given in a form which admits, as the author shows, of several interesting comparisons.

Then comes the part of the paper which will perhaps be of most general interest, seeing that it explains a simple method by which the commercial value of a gas oil may be estimated, and with a fair degree of accuracy—that is, by its gasification on the laboratory scale. It will be noted that oil is much more susceptible than coal of accurate valuation on these lines—for several reasons, chiefly connected with its being a liquid. An ounce of oil taken from a cargo is practically identical with any other ounce from the same cargo; and it can be handled more readily, and be passed into a retort without loss at any required rate; and as the retort has not to be opened for the reception of the charge, the temperature can be exactly regulated. The apparatus designed by the author and Mr. Ross for this purpose was shown on a diagram. It consists of an iron retort, which is heated in a gas muffle-furnace to a temperature which is measured accurately by an electrical pyrometer. The oil is passed slowly in by a tube projecting a short distance into the retort; while the gas produced leaves by a tube reaching nearly to the back. The gas is collected, measured, analyzed, and its specific gravity determined. In tabular form, the author gives the results of the gasification in this manner of five oils at a temperature of about 1350° Fahr. Experiments have also been made with the oils at a variety of temperatures to determine the best results, as measured by the product of the quantity of gas produced into the sum of the percentages of the hydrocarbon vapours and heavy hydrocarbons. Seeing that the illuminating power is dependent on the two latter qualities, this product may fairly be taken as

proportional to the commercial value of the oil for gas-making purposes. The figures showing this are given; and it is evident from them that oils may vary very greatly in their value, and that, before making purchases from new fields, the value of the oil should first be determined. The author is quite satisfied that the method of valuation which he submits is a suitable and efficient one. This rough outline of the contents of the paper inadequately brings out the many instructive points which are introduced.

The importance of the paper having been acknowledged by the President, Mr. G. R. Hislop opened the discussion by remarking that he believes, from his experience with Scotch oil, that great variation arises from the differences of temperature employed in its gasification. He is also at one with the author as to the importance of ascertaining the value of oils before purchasing a considerable quantity. Mr. Ellery regards the paper as one of great interest to those who have to use oils, especially now that new oils are coming into the market. He feels a little curious as to the behaviour of the oils as they come into contact with the heated surface of the retorts at the temperatures mentioned in the paper; and he suggests whether there is not a danger of them cracking and liberating the carbon. It seems to him that treating the oils at these temperatures will give rise to stopped pipes, and interfere with the values obtained from the oils. He also inquired what pyrometer Mr. Leather uses. Mr. S. Y. Shoubridge welcomes this method of testing oils, as those who are engaged in the manufacture of water gas have hitherto had to buy very much in the dark. Mr. T. O. Paterson says carburetted water-gas makers have had some mysterious working from time to time; and he is sure all will benefit from the author's researches. It is pleasing to learn from Mr. Leather's reply that he hopes to devote a good deal of time to this question, and so go further into the investigation. As to Mr. Ellery's remarks, he does not think any detrimental effect arises from the oil coming into contact with the hot surfaces, because a uniform temperature is employed; whereas, in the case of the brickwork of a superheater, some portions are hotter than others, and there is great variation. The pyrometer he uses is that of Professor Callendar, which is manufactured by the Cambridge Scientific Instrument Company. With it the temperature can be measured to 1°.

Efficiency and Economy in Gas Distribution.

A practical paper compounded from practical experience was that submitted to the members, on the above subject, by Mr. Walter Hole, of Leeds. The enormous development during the last decade in the consumption of gas has clothed the problems of gas distribution with an interest and complexity which demand the highest intelligence and untiring industry for their correct solution. Proof of the development is drawn from Leeds; and this is succeeded by a sketch of some of the work done by the author in the rearrangement and enlargement of the trunk-main system there. Going from the particular to the general, the author dilates on the economy of using longer pipes than heretofore. All sizes of pipes from 4 inches and upwards are now obtainable in 12-feet lengths; whereas formerly 3-inch to 10-inch pipes were only procurable in 9-feet lengths. The saving in weight alone is considerable; and the fewer sockets mean an equivalent reduction in the matter of lead and yarn, and labour for jointing and excavation. There is no sufficient reason in the author's view why pipes should not be cast in 15-feet lengths instead of 12-feet ones; and figures are adduced to show what economy can be effected. The objection as to increasing the length of pipes reducing the elasticity of the main, is submitted to have little foundation; and one other argument in favour of the longer length is the self-evident one that the fewer the joints, the fewer the possible sources of leakage. Pursuing the consideration of practical economical methods, he urges that it is preferable, instead of laying pipes singly, to excavate a length of trench, and then joint three of the pipes upon cross battens above ground, and over the trench, before they are lowered into position. This makes good workmanship in jointing, and saves excavation for two out of every three successive joint holes—the latter being a point of considerable importance in the case of large mains. Precaution, however, must be taken to see that the pipes are properly balanced in the slings before being lowered into the trench, in order that no strain may be put upon the joints. It having occurred to the author that, by making use of an alloy of one of the metals which expand on cooling, a tight joint might be obtained which would dispense with the present cumbrous and expensive method of setting up, he has been making experiments in this direction. He attained complete success from the point of view of soundness with an alloy containing 28 per cent. of antimony and 72 per cent. of lead. Joints run with this mixture, at a temperature of 365° C., are perfectly sound up to a pressure of 12 inches head of water, and will stand considerable deflection without leaking. However, while too expensive to use under ordinary working conditions, it may even be cheap where joints have to be made in almost inaccessible positions, involving considerable delay and labour.

For tapping mains, the author speaks of the cup-drill-tap arrangement as an admirable one; and he has a few words to say as to the effectiveness, for clearing stopped services, of the use of a simple exploder. He is of opinion that the movement in favour of subways will extend; but he has a preference for a small subway on either side of the roadway rather than a large one in the centre. In the latter case, he thinks it will be an improvement to link up the trunk mains in the subways by transverse feeds, with a system of distributing mains under the footpaths. He admits the larger initial outlay. But the advantages would fully compensate for the increased cost; and the system would probably be found the most economical in the long run. The last subject dealt with is that of electrolysis; and he urges that no question of expense should be allowed to prevent a satisfactory solution of this difficult problem. What is wanted is definite information; and he suggests that in all cases where a main is opened for the purpose of extensions or repairs in proximity to an electric tramway, that a test should be made for the presence of current. A delicate galvanometer would be useful for the purpose. Another simple test would be to connect up an ordinary telephone receiver to the severed ends of the main, when, if current is passing, a distinct rumbling or crackling sound would be heard. The communication of the results of these tests to the technical journals would, he believes, put the gas industry in possession of a mass of convincing evidence.

The paper is a many-sided one, and offered scope for an excellent discussion; but, owing to the quantity of matter that had been held over for consideration at the final sitting, the debates had all unfortunately to be curtailed in a manner which was greatly deplored on all hands. However, Mr. Leather commenced the discussion by commenting on the difficulty of using 12 feet long pipes in busy towns, in consequence of the crowded state of the subsoil. He speaks approvingly of the suggestion as to taking the actual measurements of electric current for difference of potential between the ends of severed mains when they have to be broken near electric tramways. At Burnley, where the gas-main crosses the tram-rails in one place, they have been bonded to the latter. Among the questions put to the author by Mr. W. W. Hutchinson, was one as to whether Mr. Hole has experienced any cases of electrolysis at Leeds. From the labour point of view, Alderman Miles sees difficulty in handling 15-feet length pipes as compared with shorter lengths; and he inquired of the author whether he has carried his proposal into actual practice with large pipes. It is suggested by Mr. Shoubridge that it might be an advantage in districts where electrolytic action is to be feared to attach wires in suitable places to the gas-mains, and bring them up to a convenient position so that an inspector can readily test the amount of current passing by means of a galvanometer. He also proposes that sheet iron should be introduced between the gas-pipes and the tram-rails; so as to induce stray currents to take their course through them instead of through the pipes. Mr. G. R. Hislop regards the laying of mains along footpaths as a judicious method, and in the case of leading mains their disposal as near the street gutters as possible is an advantage. A few remarks by the President, and Mr. Hole replied. He points out that, if long lengths of pipe cannot always be employed, there is no reason why longer lengths should not be used wherever practicable. He has been using 12-feet lengths of pipes down to 4 inches for some time. Although he has been watching for indications of electrolysis in connection with the gas-mains at Leeds, he has not come across the slightest indication of anything of the kind having occurred; but one or two service-pipes have come within debateable lines. He has not been able to get pipes of over 12 inches diameter in longer lengths than 12 feet; but he has been trying, and is now entertaining prices for them. In places where he thinks there is

danger, he has adopted the protective expedient of covering the pipe with a shield of wrought-iron plate.

A Revolutionary Meter.

Since the days of Clegg and Richards, the principles upon which gas-meters have been constructed have not changed, though many improvements and refinements have been introduced. One of the most radical departures from the established methods of gas registration was introduced to the members in the paper by Mr. T. G. Marsh, of Manchester. It describes what is to be known under the appropriately descriptive designation of the "Rotary" meter. On ascending the platform, Mr. Marsh had with him a sample of the meter; and he caused some amusement by remarking that he believes he is the first engineer who, on starting to read a paper, has carried to a platform a meter in size tantamount to a 500-light wet gas-meter. In the paper the author told his audience three things: He explained to them what suggested the meter, then its useful applications, and finally its constitution. We prefer in this abstract to take the point as to its construction first. The inventor is Mr. Thorp; and his application of a very old principle to gas measurement is certainly novel. We miss in the paper a terse description of the meter. In its construction, a number of vanes are attached to a central vertical spindle, which operate counting mechanism above; and a valve, baffle-plate, and guides, serve to direct and distribute the current of gas on to the vanes so as to obtain uniform results. The pivoting of the vanes has received the most careful attention; and it has been found that, by using one of the hardest jewels, resting on a very hard metal point, not the slightest perceptible wear has taken place, even after several months of constant running. A great convenience is the readiness with which the parts of the meter can be detached for cleansing purposes; and this, its simplicity, its smallness, and its low cost give to the meter a scope not possessed by meters of ordinary construction. As to its efficiency, the author points out that for all quantities above 5 per cent. of the capacity of the meter, the registration is correct within a small percentage. Of course, the capacity percentage varies a little according to the size of the meter. The larger the meter, the smaller the percentage below which it ceases to measure correctly. It is equally accurate for high and low pressure supply. Neither difference in specific gravity, nor pressure within wide limits, affects the accuracy of the meter.

The want of a simple measuring arrangement in connection with water-gas plants led to the devising of this meter; and it is evident that it can be applied with advantage in many positions where the ordinary system of measurement is entirely impracticable. The author instances its application to the measurement of foul gas, in order to further efforts to obtain the greatest yield from coal; to the sectionizing of the retort-houses, in order to determine the relative merits of various descriptions of settings; to sectionizing in distribution; to the measurement of large volumes of producer gas; and to the checking of the accuracy of large meters that have been in use without tests for a long period. There appears from this to be a good scope for the meter in directions other than that of the registration of gas for the purposes of sale.

Again, owing to the scant time available, there was only a brief discussion of this novel invention. The first question was asked by Mr. Leather, who wished to know what pressure the meter will work at. He was followed by Mr. John West; and he thinks it is a valuable invention, but, of course, as he points out, it depends upon the accuracy of its measurement. As to the application of the meter for the measurement of foul gas, he assumes that corrections for temperature and pressure would have to be made. Regarding the use of the meter for this purpose, it appears to Mr. Isaac Carr that there will be a considerable deposit on the vanes, in which case the registration would be interfered with. However, he can see a field of usefulness for an apparatus of the description. The opposition of power gas will, he also thinks, bring the system of differential rates for ordinary gas more into vogue than at the present time; and some such appliance as this will be of great use in subdividing the gas to be charged at different rates. For this purpose, it will be sufficiently accurate. Any inferential apparatus such as this, however, will never be passed by the Board of Trade for actual registration. Mr. W. W. Hutchinson also appreciates the useful application of the meter, in a secondary way, for obtaining records. The prospect of being able to measure foul gas also gives great pleasure to Mr. Hislop. The usefulness of a small instrument of this character for measuring gas supplied to fires, geysers, and such like in hotels, in order to approximately ascertain the charge to be made, is a point advanced by Mr. Ellery. But as to foul gas, he thinks the vanes are so fine that there will be difficulty with the tar held in suspension. In his answer to the various speakers, Mr. Marsh supplies the information that the new meter will work at a less pressure than any ordinary station meter. It can be made to work if necessary at a pressure of 1-10th inch; and it will measure accurately at any pressure from 2-10ths of an inch up to 50 lbs. It will, of course, be absolutely necessary, if correct measurement of foul gas is required, to take the temperature and pressure during the time the gas is passing. He has not yet had any experience with continuous working for a length of time on foul coal gas; and he does not expect that a meter used for measuring crude gas will be kept going constantly without cleaning. He illustrated the readiness with which the meter can be taken to pieces and cleaned. As to the size of the meter, it may always be considered as double the diameter of the pipe. He has no intention at present of trying to supplant by the new invention the smaller types of meter; and he frankly admits that it is not yet applicable to the sale of gas. But it is easy to see there are many fields in which it will be of great utility.

It was much to be regretted that at this point, owing to the protracted sitting, a large number of the members left the hall, and few were left to hear the paper which Mr. C. E. Jones had prepared, at great trouble and a vast expenditure of time. Portions of it were read by the Hon. Secretary; but its continuity was marred by the character of the excisions made. The treatment of an author in this way is not encouraging to contributors of papers. The question asked by Mr. Jones in the title of his paper was

Is Gas Capital in England and Wales Excessive?

But it was not by any means an easy one to answer in few words. By the time he had finished his examination of the subject, he had found the topic was of such an absorbing and polyhedral character that his manuscript extended to a length that, even compressed into type, the contents filled twenty-two full octavo pages. As a piece of composition, the paper is good; as an argument, most of the points are sound and incontrovertible; there are others perhaps upon which different men hold different views; but, as an opening for a debate, notwithstanding the characteristic light touch of the author, a discreet application of the blue pencil would have made it more suitable. It was far too long for its special purpose; and it would have found a better place as a studied contribution to the "Journal" pages. The subject is one which has been much neglected; and it has never been treated, so far as memory takes us, in the particular mode adopted by the author. Mr. Jones submits, and anyone who gives thought to the question will not gainsay him, that taking stock of capital is quite as necessary a proceeding as taking stock of stores, &c., and should receive the same careful attention. The capital audit reveals the true condition and success in certain cases, as well as throws the searchlight on others. Capital, he says, should be represented by land and works and property intrinsically equivalent to monetary value as shown in the balance-sheet of the undertaking, after allowing 10 per cent. as floating capital. But uniformity in gas capital does not obtain, never did obtain, and, the author admits, is probably unattainable. A desire to condense induced him to confine his attention to Statutory Gas Companies in England and Wales; and nearly 400 of them figure in his investigations. He concedes that it would be an unjust act to impose on works a hard-and-fast line or a limit beyond which it would be perilous to go. But, at the same time, notwithstanding disturbing causes, many undertakings are, he holds, overcapitalized.

The author catalogues the causes of high capital under letters extending nearly half way through the alphabet. That preliminary expenses should constitute a perpetual charge on an undertaking, he contends is neither desirable nor justified. Condemnation of the extravagant costs (often capitalized) incurred in parliamentary warfare follows. Efforts, in his view, should be made to eliminate such charges from the capital account by debiting them to a suspense account, or to revenue direct. Raising money at a high rate of interest is entered as a piece of bad finance; and he asserts that many gas companies do not exercise sufficiently the borrowing powers bestowed upon them by the Legislature.

The cost of land, too, is an elastic and uncertain item; and, in described instances, he maintains that it is sometimes advisable to go further afield, and incur the expense of a trunk main than pay fancy prices for land. Lack of skill in the design of works is another "cause;" and while payment of interest out of capital may be justified in certain cases, he very rightly deprecates it on account of its tendency to the inflation of capital. Then, unless works are urgently needed, contracts made at times and seasons unfavourable to economic construction should be avoided. The singular practise of the payment of directors by a percentage on the capital subscribed is suspected by the author of a tendency to increase the capital expenditure in a manner not fully warranted. The system is liable to abuse, and not worthy of being perpetuated. The character of the supply, and the confusion of ideas as to charges to capital or revenue account, have their effect in producing high capitals. Finally, he deplores the refusal of legislative sanction for the creation of redemption funds. After all this, it is quite refreshing to find a contra account of methods and opportunities contributing to a reduction of capital. There are the auction clauses (but these operate more to the advantage of prosperous undertakings than of those standing in greater need of assistance), the prepayment system, the invention of columnless gasholders, water-gas plant, and the saving which can be effected by working at higher distribution pressures, and the reduction of the disparity between day and night consumption. To every question, however, there are two sides; and it comes within the province of the author to point to arguments against reduction of capital—chief among which is the effect upon the price obtained in the transfer of an undertaking to a local authority.

What then, asks Mr. Jones, is a sufficiency of capital per ton of coal carbonized? It has been contended that it should not exceed £5 per ton, including even floating capital. This "liberal" standard might apply to modern works unencumbered by causes and effects; but it appears to him to be too drastic for general adoption. A table is here given—constructed from a diligent, and evidently laborious, arithmetical investigation into the capital accounts of nearly 400 gas companies. The undertakings are classified into nineteen groups; and the table presents plenty of range for an instructive study. The capital employed per ton of coal is found to vary between £17 5s. and £5 2s. 1d.; and the reduction is not a progressive one in proportion to coal carbonized, gas sold, miles of main, or number of consumers. But Mr. Jones is not without belief in the possibility of reducing the enormous differences shown, by intelligent and persistent financial effort.

The author submits that the capital of gas companies is, generally speaking, higher than is warranted by fact, has not its equivalent in works, and should be reduced. About 100 of the companies he has investigated have capitals abnormally high; while many have capitals abnormally low. The present capital having received legislative sanction, it is not, he suggests, unreasonable to ask Parliament to give facilities to reduce it by applying section 122 of the Companies Clauses Consolidation Act, 1845, or some modification thereof, to gas companies seeking relief from over-capitalization. In this connection, he further suggests the possibility of arranging a division of surplus profits between the companies and the consumers; and, where the sliding-scale operates, the profit over 10 per cent. might be applied towards a gradual reduction in capital.

There was really no discussion; the members feeling that the topic dealt with was so large, and portions only of the paper had been read so hurriedly, that it was impossible to adequately grasp their import. The author expressed the opinion that this experience showed the necessity of circulating papers beforehand, and taking them as read. It was apparent—and small wonder—that Mr. Jones was very disappointed at the barren result of his labour, more especially as he had left home for the day purposely to read the paper. It is to be hoped that there will be a future opportunity for discussing the subject.

Automatically Lighting and Extinguishing Public Gas-Lamps.

The last subject to which the attention of the members was turned was the above; and the paper was contributed by Mr. W. R. Mealing. It is a question which ever has its attractions for gas engineers; but it is essentially one which, like all innovations proposing a radical change in that which exists, needs the substantiation of personal or wide experience before engineers will extensively or even generally adopt it. But it may not be out of place here to remind readers that the particular device which the author of the paper had to bring before the members has received a lengthened and favourable notice in the "Journal," from the simple fact that the apparatus has been proved of value by trials of some duration in sundry places. In the paper, the author points out the obvious disadvantages of circuit systems of lighting and extinguishing lamps—such as the cost of installation; and the fact that a single defect may throw into disorder the lighting of the whole of the lamps comprised in one circuit. The inconveniences, troubles, and dangers in such an event are many and apparent. The independent control of each individual lamp by a reliable apparatus appears far preferable, as any accidental defect can only affect the one lamp, and so can be quickly remedied. In addition to this, a separate apparatus can be made to actuate a midnight arrangement in a cluster of lights. As the author points out, there are several essential requirements which such an apparatus must fulfil. It must be an economizer, simple, accurate, compact, durable, and adaptable to present fixtures. Following these introductory observations, Mr. Mealing describes the ingenious appliance which has been devised and perfected by Mr. John Gunning, of Bournemouth. The principle of the apparatus is simple. It has clockwork mechanism, which operates time-adjustable pawls—two for single lights, and three for cluster midnight arrangements; and these pawls in turn operate a rotatory gas-tap fitted with a star wheel, the movement of which opens and closes the gas-ways to the burners. Of course, a pilot-light is a necessity. The rewinding of the clock and the alteration of the times for lighting and extinguishing can be attended to when the lamps are being cleaned. The paper runs so much on the lines of the article published in the "Journal" for April 15, that to enter into a full description or any explanation of the working, or of the commendable features of the device, would be merely to repeat what has previously been said. Besides which, it will be found that the paper itself has been written with such coherent brevity that it is useless attempting further summary.

Forced meagreness was also the feature of the discussion on this paper, and the durability of the appliance its chief point. Alderman Miles's remarks tended in this direction, He asked how long the device has been in use at Bournemouth for both lighting and extinguishing, and whether a sample could be obtained for trial. Of great utility, if thoroughly durable, is the view of Mr. S. Y. Shoubridge on the apparatus; and he thinks if Mr. Gunning has invented an automatic lighting and extinguishing appliance that will stand changes of temperature, he has done something to deserve the thanks of gas engineers. But Mr. Shoubridge has been making trials in his district with samples of a similar invention; and the number of failures, he says, precludes the possibility of introducing that particular system. Mr. Jones, of Pontypridd, fears the constancy of the mechanism. He has tried several types of arrangements having the same object; and they have not given satisfaction. If an apparatus of this kind would only save the gas wasted under the present system of lighting and extinguishing, it will, in his estimation, be a very good thing. Mr. W. W. Hutchinson thinks the author rather summarily dismisses the circuit system. For a considerable time, Mr. Robert Fish has given this appliance a severe test; and so satisfied is he with it, that he is going to fit it to a number of lamps. The members were informed by Mr. Mealing, in reply, that the Company who are introducing the appliance are prepared to supply it for an annual rental of 5s. each per annum. The mechanism, he says, is made by the best processes; and, as to its utility, Mr. Norton H. Humphrys has had a number under test for six months or so, and speaks highly of them. In fact, he is now introducing them for high-power incandescent gas-burners. The apparatus for both lighting and extinguishing has only been in use at Bournemouth for a few months; but now the Corporation are fitting it to the high-pressure gas-lamps. The form of apparatus for extinguishing only has been in use for some years. With this discussion, the technical business was completed.

Elections and General Business.

Then the few members left turned their attention to the report of the Scrutineers; and the announcement of the names of those who have been elected to steer the Institute through what will be a most momentous year, was hailed

with pleasure. Mr. Andrew Dougall takes his seat as President, and no worthier man nor one more qualified, from every point of view, for the difficult work before him could have been found. He has the confidence of the members, is resourceful, and has a genial and conciliatory manner which will help him to tread where many other men would go fearful of the consequences. He has two good lieutenants in the Vice-Presidents, Mr. T. H. Martin and Mr. D. Irving, and the Council is, as a whole, exceptionally strong. Mr. Dougall, in acknowledging his election, earnestly hoped that he would have the co-operation of the Council and the members generally in carrying on the critical work before them. The members responded to this remark with an encouraging cheer.

The roll of the Institute was then substantially extended; there being no less than 22 new additions to the class of members and 8 to the class of associate members. There were also eight transferencies from the lower to the higher class. The names of several defaulters were ordered to be ruled off the register.

The dignity of honorary membership was conferred, in accordance with custom, upon the President of the Société Technique du Gaz en France; and a suggestion by Mr. C. E. Jones that a similar honour should be bestowed upon Professor Vivian B. Lewes was received with approbation by the members, and the President promised its consideration in the usual course by the Council.

London was fixed upon as the next place of meeting; and then numerous votes of thanks were passed—thus concluding the business part of the thirty-ninth annual meeting, which had been full and varied in character, and of excellent quality; the only regrettable part being the pressure and summary dismissal of papers at the last sitting.

THE SOCIAL DOINGS OF THE WEEK.

The pleasure of the visitors to Southampton was excellently catered for, and thoroughly enjoyed. The only regret was that Old Sol, who beamed so benignly upon Southampton on Tuesday, failed to pay his important contribution to the outdoor recreation during the succeeding days. An overcast sky and occasional rains—at times very heavy—did their best to mar the delightful changes arranged for. But the visitors were not easily dejected; and the pleasure derived from the various events was always greater than the prospect promised.

As was mentioned in the first part of the summary, the members were formally and heartily welcomed at the opening of the business sittings by the Mayor (Mr. F. A. Dunsford), and the Chairman of the Gas Company (Dr. T. W. Trend); and then, shortly after the close of the meeting on Tuesday, they were entertained to luncheon by the latter gentleman and his directorial colleagues in the Philharmonic Hall. Dr. Trend was, of course, in the chair; and at his right-hand sat the President (Mr. S. W. Durkin) and at his left, his Worship the Mayor. The Sheriff of Southampton (Dr. Weston), Mr. C. Crowther Smith, the Secretary of the Gas Company, Mr. William Matthews, the Corporation Water Engineer, and several other local gentlemen were present. Altogether, there were about 200 guests; and by one and all the generous hospitality of the Company was immensely enjoyed. Following the luncheon, came the usual toast list; and several speeches appropriate to the occasion were made. The members, at the instance of Mr. T. O. Paterson, whose remarks were supported by Mr. W. A. Padfield, very heartily expressed their thanks to Dr. Trend and his colleagues for the handsome character of their welcome.

Later in the afternoon, Mr. W. Dale, Fel. Soc. Antiq., by the kind permission of Mr. W. Burrough Hill, gave a description to an interested following of the historic pictures (collected by Mr. Burrough Hill) of old Southampton in the small hall at the Philharmonic Rooms, and subsequently conducted a party on a tour, in the course of which many of the features of antiquarian interest at Southampton were visited and inspected. The Southampton Gas-Works were also open to the members, and a considerable number found their way there. At the invitation of the Mayor, a party also visited the Audit House, and inspected the old regalia and other municipal treasures. A goodly number, accompanied by their lady friends, accepted the invitation of Messrs. Rogers and Sons, to inspect their magnificent display of rhododendrons; and those who were fortunate enough to have the pleasure, spoke highly of the magnificence of the flowers.

Many occupied Wednesday afternoon in visiting, by permission of the Director-General (Colonel D. A. Johnston, R.E.), the Ordnance Survey Office, where all the processes for the production of Ordnance Survey maps were shown in operation.

Inclement weather notwithstanding, there was a large company at a conversazione given by the President and Mrs. Durkin at the Victoria Rooms on Thursday evening. The visitors were gracefully received by their hosts. Music, songs, and recitations were the principal features of the programme. Light refreshments were served in the card room; and in several other ways the entertainment of the guests was provided for. Mr. and Mrs. Durkin and the numerous talented local friends who assisted them earned the gratitude of all present.

A lowering sky and drizzling rain greeted the visitors on Friday morning—the day of the excursion to the Isle of Wight; and everyone predicted that a good and inviting programme was going to be spoilt. But the worst fears were happily not realized. Ladies and gentlemen to the number of somewhere about 250 wended their way to the Royal Pier, clothed with all available protection against the rain, which unfortunately was falling heavily as they boarded the steamer *Lorna Doone*. About an hour's run brought the excursionists to Ryde Pier; and by that time the rain had ceased, though overhead conditions where not of a character to raise any bright hopes. However, about half past ten, the numerous party were aboard coaches and chars-a-banc, and rolling through the town. Away they passed rapidly over Ashey Downs, through Newport, the capital of the Island, and about noon they arrived at the historical village of Carisbrooke. The ride was a pleasant one, although the beauties of the scenery through which the travellers passed did not meet the eye under the best circumstances. From the main street of the village, the numerous party walked to the ancient castle, which is situated on a hill, the slopes of which are beautifully wooded, and the fresh and variegated foliage was really good to see. On the road, it was impossible to restrain passing a few minutes here and there in feasting the eyes on the lovely landscape. On reaching the castle, the ruins of the old parts were examined with curiosity; and the visitors were not long in searching out the most attractive parts. Within half an hour after their arrival, an excellent luncheon was served in a large marquee on the Castle Bowling Green, by the gracious permission of H.R.H. Princess Henry of Battenberg. Shortly before two o'clock, the members were photographed; and it may interest those who were present to learn that in every respect the pictures taken have turned out splendidly—the rising ground and the portions of the old castle in the rear forming an excellent background. A few minutes remained for further inspection, and then the party walked back to their coaches, and soon commenced the second and final stage of their drive. There was a heavy fall of rain as the village was left, but it was for a brief space only, and then the journey was continued in comfort, *viâ* Blackgang and Ventnor, to Shanklin. From Ryde to Shanklin by the road traversed, the distance is about 32 miles. At the latter place, tea was served at The Institute, and there the visitors were welcomed by Messrs. Cooper and Young, the Chairman and Deputy-Chairman of the local Gas Company, and the Engineer (Mr. Frank C. Taylor). To this gentleman, by the way, the members of the Institute are indeed deeply indebted for the active part he took in perfecting, by every attention to detail, the several arrangements for the day. Hearty were the thanks accorded to him before the company left the tables. On the suggestion of Mr. William Hardie, too, the opportunity was taken to thank the ladies for having braved the uncertainties of the weather, and adding by their presence to the enjoyment of the day. By invitation of Mr. Taylor, the visitors had free entrance to the world-renowned chine, the cliff lift, and the pier. Here the *Lorna Doone* arrived shortly after 7.30, and made for Southampton, calling at Southsea and Ryde. Rain fell heavily nearly all the voyage; and, though no one on board would have missed the day's outing, nearly all, it may confidently be said, were not sorry when the steamer was moored alongside Southampton Pier at 10.15 o'clock, after an absence of some thirteen hours. There the President bid adieu to his visitors; and thus ended the 1902 meeting. Is it the last gathering the members will have this year?

GENERAL REPORT.

The Thirty-ninth Annual General Meeting of the Institute was held on Tuesday, Wednesday, and Thursday of last week, at the Victoria Rooms, Southampton—Mr. S. Westall Durkin in the chair. There was a good attendance of members.

Welcome to Southampton.

The President opened the proceedings by calling upon The Mayor (F. A. Dunsford, Esq., J.P.), who said it gave him great pleasure to welcome the Institute to the beautiful town of Southampton, which in the last ten years had been developing rapidly—he might almost say phenomenally. During their stay, they would have an opportunity of seeing the beauties of the neighbourhood—the Common, the New Forest, the Isle of Wight, and all those attractions which were so dear to Hampshire people. They would also be able to see the difference between electric and gas lighting; and he had little doubt that they would give the preference to the former. He concluded by giving all the members of the Institute a hearty welcome.

Dr. T. W. Trend, J.P., as Chairman of the Southampton Gaslight and Coke Company, cordially supported the welcome given by the Mayor. The pleasure which it would have afforded him to do so in the ordinary course, was greatly enhanced by the fact that the President was his old friend Mr. Durkin, the Manager of the gas-works, who in a few months would celebrate his Jubilee of service, so that he must have begun very early, as he was not yet by any means an old man. He congratulated Mr. Durkin on his well-merited position, and the Institute on having such a thoroughly practical man at their head. He hoped they would carry away many pleasant memories of their visit, as well as information which would incite them to renewed exertions in the interest of their profession.

The President proposed a hearty vote of thanks to the Mayor and Dr. Trend for their congratulatory remarks; and the motion was at once carried unanimously.

The Mayor, in acknowledging the vote, said he had omitted to state that there were various interesting relics connected with Southampton, including the regalia, which were very ancient.

Confirmation of Minutes.

The minutes of the last meeting were confirmed.

Appointment of Scrutineers.

Mr. H. Wimhurst (Sleaford) and Mr. E. D. Sapey (Horsham) were appointed Scrutineers of the ballot-papers.

The Late Mr. Chester.

The President said that since the last meeting the Institute had lost a very able man in the person of their late friend Mr. Chester, and he thought it only their duty to pass a vote of condolence with Mrs. Chester and the family in their bereavement. This he would formally move.

The resolution was carried by the members rising silently in their places.

The Report and Accounts.

The President moved the adoption of their annual report, which had been circulated among the members, and the principal points in which were noticed in the "Journal" for the 3rd inst. (p. 1480).

Mr. T. O. Paterson (Birkenhead) seconded the motion, and it was carried unanimously.

Mr. T. H. Martin (Barnet) then moved the adoption of the statement of accounts.

Mr. W. A. Valon seconded the motion, which was carried unanimously.

Mr. R. Porter (Elland) drew attention to the large sum written off for subscriptions (£65 2s.). He remarked that if it was necessary to write off such a considerable amount in one year owing to loss of members, one would naturally expect that the item of unpaid subscriptions would be reduced; but, on the contrary, this seemed to be an ever increasing item. During the last four years, no less than £174 had been written off, and still they had subscriptions in arrear to the amount of £144 at the end of the year.

The President said he understood the explanation was that the members did not pay their subscriptions promptly. They were therefore written off as defaulters; and, of course, their membership ceased.

Awards of Premiums.

The President next announced the following awards for papers read at last year's meeting:—

First Prize (£10 and the President's Medal).—To Mr. Walter Grafton, for his paper on "The Effect of Quality and Pressure on the Efficiency of Incandescent Gas Lighting, having regard to Economy."

Second Prize.—To Mr. R. Porter, for his paper on "British Water-Gas Practice."

Third Prize.—To Mr. W. Sugg, for his paper on "High and Low Pressure Incandescent Gas Lighting."

Mr. Porter (the only recipient present) acknowledged the honour conferred upon him, which he hardly expected, considering the lively reception given to the reading of his paper.

The Amalgamation Scheme.

The President said the next item on the *agenda* was one of considerable importance; but he did not propose at that stage to offer any remarks upon it. He would simply move the resolutions of which notice had been given:—

(*a*) To admit to the class of Honorary Members such members of the trading community as shall, in the opinion of a clear two-thirds majority of the Joint Councils, have rendered distinguished services to the profession of gas engineers, or have specially promoted the interests of the gas industry.

(*b*) That existing Members of both Societies who, having ceased to hold positions as Engineers or Managers of gas undertakings, would be ineligible under the proposed new rules, be dealt with under the terms of the foregoing proposed resolution; and those existing members of both Societies acting solely in the capacity of Secretaries of gas undertakings be eligible for election as Associate Members of the proposed new Association.

He trusted that the members would accept these resolutions, and have confidence in the new Council who would carry on these deliberations.

Mr. A. Dougall (Tunbridge Wells), in seconding the motion, said that the Council were unanimous in asking for these powers.

Alderman J. Miles (Bolton) thought the members should have a little further information; and he asked the President to kindly explain the precise operation of the second resolution. He was afraid that many members of the Institute did not quite understand the gauntlet they would have to run, and whether they would be entitled to be re-elected under this rule. He considered it would be a great pity if members, whether they were distinguished or not, should feel that there was any likelihood of their being excluded from an Institute with which many of them had been very long connected. He did not wish to raise a word of contention, for there was no one more ardently desirous of amalgamation than he; but, as he had said before, he did hope the proposal would be carried out on just and equitable lines. He had every confidence in the judgment of the Council; but there was a fear—a great fear—that many humble members of the Institute, who might have left the gas profession from no fault of their own, but from causes over which they had absolutely no control, might be excluded. Such a case had come under his notice that morning. A gentleman told him he was leaving the profession as an active manager, owing to circumstances over which he had no control whatever, who had been a member for 35 years. He could hardly be described as a "distinguished" member; but there was no worthier gentleman in the Institute. It might be that, through not being very well known, he would be overlooked; and, if so, he felt it would be a great hardship. If the President could kindly give some indication of how such members were likely to be dealt with, he should be glad.

The President said Mr. Miles might trust the Council to fully consider any such case as the one that he had mentioned.

Mr. W. W. Hutchinson (Barnsley) expressed the hope that the Council would take the members a little more into their confidence with regard to the *modus operandi*, for this was a very weighty matter. He was strongly in favour of amalgamation; and should much regret if anything occurred to prevent it.

The President said he did not think he could go any further into the matter. No doubt the Council would give due attention to all these things.

Mr. C. Stafford Ellery (Bath) remarked that he was as anxious as anyone for amalgamation, but wished to know

whether, if the two resolutions were carried, the thing would be settled.

The PRESIDENT: Certainly not. The members would settle it, not the two Councils. They would confer together, and a scheme would be brought before the members of both the Institute and the Institution. There was so far nothing settled.

Mr. ELLERY: This is the beginning of a scheme?

The PRESIDENT: Yes.

Alderman MILES asked if there would be a list prepared of those members who were proposed to be excluded, and submitted for the approval of the members.

The PRESIDENT said he could not say what the two Councils would do in this respect.

Mr. C. WOOD (Bradford) said he had every sympathy with the observations of Mr. Miles, and it might reassure him, as well as some others, if he (Mr. Wood) said, being a member of the Council of the Institution as well as of the Institute, that the Council of the Institution were in favour of re-electing every member who had been a gas engineer. He had not the slightest doubt that if members would leave the matter in the hands of the Council, every one of those members would be elected.

The resolutions were then put and carried unanimously.

PRESIDENT'S ADDRESS.

The PRESIDENT then delivered his Inaugural Address, which was given in the "JOURNAL" last week (p. 1550.)

Mr. VALON moved a vote of thanks to the President for his address. In doing so, he said the members were all sorry to hear that the state of Mr. Durkin's health had been such as to render it necessary for him to make the address shorter than it would otherwise have been; for, no doubt, he would have given them many other points for profitable consideration. He (Mr. Valon) had been much interested in the remarks on retorts and the question of fuel. But it would be out of order to criticize the address; and he would therefore simply move the vote of thanks.

Mr. J. WEST (Manchester) said he had much pleasure in seconding the motion. He felt great sympathy with the President in his early struggles to obtain his education, which reminded him strongly of his own youthful experience. He was very glad the President had referred to this matter, because he felt that many of the young men of the present day did not sufficiently appreciate, and take advantage of, the opportunities now given to them. In Manchester, they had spent £250,000 on one Technical School alone; and he was sorry to say that young men did not take the advantage they might of these facilities for obtaining the best technical knowledge.

The motion was put by Mr. VALON, and carried unanimously.

The PRESIDENT briefly acknowledged the vote.

THE LECTURE AND PAPERS.

The reading and discussion of papers was then proceeded with. They were taken in the following order:—

Tuesday.—(1) "Large Gas-Engines and the Gases Used by Them." By DUGALD CLERK, of London. (2) "The Maintenance of Incandescent Gas Burners by Gas Companies." By NORTON H. HUMPHRYS, of Salisbury. (3) "The Fittings Business as an Aid in the Sale of Gas." By ROBERT WATSON, of Hertford.

Wednesday.—(4) "The Electrolysis of Gas-Mains." A lecture by Mr. JAMES SWINBURNE, M.Inst.C.E. (5) "The Steam-Turbine as a Motor for Blowing and Exhausting Apparatus." By W. D. CHILD, of Romford. (6) "Sunday Rest for Gas-Workers." By R. G. SHADBOLT, of Grantham.

Thursday.—(7) "Efficiency and Economy in Gas Distribution." By W. HOLE, of Leeds. (8) "Valuation of Gas Oils." By J. P. LEATHER, of Burnley. (9) "A New System of Gas Measurement." By T. G. MARSH, of Manchester. (10) "Is the Gas Capital in England and Wales Excessive?" By C. E. JONES, of Leyton. (11) "The Automatic Lighting and Extinguishing of Public Lamps.' By W. R. MEALING, of London.

THE BENEVOLENT FUND.

The Annual Meeting of Donors and Subscribers to the Benevolent Fund was held at the conclusion of the morning's proceedings on Wednesday; the chair being taken by the PRESIDENT.

The minutes of the last meeting, and the report of the Committee, were taken as read.

Mr. D. IRVING (Bristol) moved the adoption of the report and accounts, and, in doing so, said he wished to enter a mild and respectful protest against the arrangement of holding the meeting at the end of a long morning's sitting, when they could not reasonably expect gentlemen to remain. This arrangement seemed just calculated to keep the Benevolent Fund in the background; and he trusted that the Committee would consider the possibility of making some improvement, so as to secure a better attendance.

Mr. R. PORTER (Elland), in seconding the motion, suggested that a special appeal should be made to the members to give more support to the fund. He thought it required a special appeal only, which might very well come from the President—an opportunity being taken when the largest number of members were present. He had spoken in favour of the fund to one or two friends who had not taken much interest in it before; and they had readily responded—one giving half-a-guinea, another a guinea. In this way, he obtained several subscriptions. If other members would use their personal influence in a similar manner, he believed the fund might be considerably augmented.

Mr. C. STAFFORD ELLERY (Bath), as one of the oldest members of the Committee, said the question raised by Mr. Irving had not been lost sight of; but the difficulty was to arrange for the meeting at any more convenient time. The only suggestion he could make was that the Committee should be more generous in giving relief. They had been in this difficulty—that when cases had arisen at the beginning of the year, if they were then too generous, the funds would run out, and other cases coming later might suffer. But if it was the feeling of the meeting that the Committee should be more generous, and in consequence they had a balance on the wrong side next year, they could make a strong appeal to the general body for assistance. He had heard it said in other philanthropic institutions that nothing succeeded like a bad balance-sheet. Hitherto they had made a point of coming forward every year with a balance to the good; and perhaps this accounted for the apparent indifference. He believed that it was only apparent, and that if the Committee were more generous in their votes, and then came forward next year and said they had not only no money, but had actually "overrun the constable," a very effective appeal might be made with good result.

Mr. W. H. MORGAN (Rhayader) said he concurred with Mr. Ellery; and if it would help the matter, he should be pleased to propose that the Committee be more generous. It could, at any rate, do no harm to try the experiment.

The resolution for the adoption of the report and accounts was then put and carried unanimously.

The PRESIDENT said it might be well to suggest to the Council that the Benevolent Fund meeting should be held, and the matter brought before the members, some morning at ten o'clock. It would not take very long; and he did not see why it could not be done.

Mr. ELLERY remarked that he made the same suggestion some four or five years ago.

The PRESIDENT said the next item on the *agenda* was suggestions for the Committee; but this had already been dealt with. The only remaining point, therefore, was to ask members to forward particulars of deserving cases.

This concluded the proceedings.

REPORT OF THE SCRUTINEERS.

The SECRETARY (Mr. Walter T. Dunn) read the report of the Scrutineers as to the election of office-bearers for next year, as follows:—

President.—A. Dougall, of Tunbridge Wells.

Vice Presidents.—T. H. Martin, of New Barnet, and D. Irving, of Bristol.

New Members of Council.—J. Carter, of Lincoln, S. R. Ogden, of Blackburn, Matt. Dunn, of Goole, and H. Townsend, of Wakefield.

Auditors.—W. D. Child, of Romford, and Samuel Wood.

Honorary Secretary.—J. Davis, of Gravesend.

The following additions were made to the roll :—

MEMBERS.

Barrett, F., Ramsbottom.
Bates, A. G., Wokingham.
Dyer, R. H., Colnbrook.
Grafton, W., Beckton.
Halliday, W., Cowes.
Halliwell, S. E., Littleborough.
Hill, W., Stalybridge.
Jackson, A. J., Padiham.
Jones, E., Pontypridd.
Jowett, T., Blackwell.
Mottram, A. E., Ossett.
Noake, F., Walton-on-the-Naze.
Offord, C. W., Enfield.
Paternoster, F., Felixstowe.
Peaty, H., Longport.
Pye, F. A., Chester.
Smith, W. J., Carlisle.
Topley, W. W., Croydon.
Wadham-Smith, C. J. P., Brigg.
Wilson, R., Malta.
Winter, W. E., Cowes.
Young, A. F., Cockermouth.

ASSOCIATE MEMBERS.

Bedford, C., Durham.
Broadberry, A. F., New Southgate, N.
Dickinson, E. G., Sydenham.
Farrand, F. W., Ryde.
Hendrickson, A. V., Lower Sydenham.
Irons, W. R., Gosport.
Taylor, F. W., Frome.
Wellens, E. J., Middleton.

TRANSFERENCES.

The following were reported to have been transferred from the class of associate members to that of members :—

Buckley, H., Windsor.
Dann, T., Bedford.
Duff, J. R., Morecambe.
Keyte, G., Workington.
Lewis, G. P., Aldershot.
Smith, J., Congleton.
Stephenson, S. O., Tipton.
Tooms, J. G., Waterford.

Mr. DOUGALL thanked the members for the honour they had done him in electing him as President. He looked forward to a good deal of work during the year, especially on the question of amalgamation; but he hoped he should have the hearty co-operation of the Council and the members generally in guiding that work.

ELECTION OF AN HONORARY MEMBER.

The PRESIDENT then proposed as an honorary member the President of the Société Technique du Gaz en France (M. Piaton). He at the same time stated that he had received a letter announcing the decease of M. Alavoine, who had been an honorary member since 1886.

Mr. C. E. JONES seconded the motion, and said he should also like to see Professor Lewes elected as an honorary member. If he were in order, he would move it after the resolution was carried; but if not, he would suggest it for the consideration of the Council.

The motion was put and carried unanimously.

The PRESIDENT said the suggestion made by Mr. Jones would be considered.

PLACE OF NEXT MEETING.

Alderman MILES said it had always been understood that the Institute should meet alternate years in London, and he would move that the next meeting be held there.

Mr. PATERSON seconded the motion, which was carried unanimously.

VOTES OF THANKS.

The PRESIDENT said he had to propose votes of thanks to Colonel D. A. Johnston, R.E., Director-General of the Ordnance Survey Department, for giving the members permission to visit the Ordnance Survey Office, and for the special facilities he arranged for them; to Mr. Burrough Hill, for his invitation to visit the ancient Southampton Exhibition; to Mr. William Dale, F.S.A., for describing the pictures, and conducting the members to view the principal features of antiquarian interest in Southampton; and to Messrs. W. Rogers and Son, for their invitation to the Rhododendron Show at their nurseries.

The proposition was carried unanimously.

Mr. J. BRADDOCK then proposed a vote of thanks to the readers of papers. He said the members were much indebted to these gentlemen for the labour and research they had bestowed, and for the records of their experience.

Alderman MILES seconded the motion. He said the style and general excellence of the papers had been fully up to the average, if not above it. It gave him great pleasure to find that at their thirty-ninth annual meeting they were able to produce papers of the number and quality of those they had had before them.

The vote was accorded unanimously.

On the motion of Mr. F. W. CROSS, seconded by Mr. R. FISH, a vote of thanks was passed to the Scrutineers.

Mr. WEST next proposed a vote of thanks to the Council, which he said was this year a very important vote. The Council had had to deal with many important matters, and especially they had been struggling to bring about a combination of the two Institutions. A great amount of credit was due to them for the way in which they had brought the matter before the members; and he hoped the resolution which had been passed would be carried out in a liberal spirit, embodying what Mr. Charles Wood had said in answer to the questions put to him. There seemed every hope that before long they would be able to meet as a united body.

Mr. SHOUBRIDGE seconded the motion, which was carried unanimously.

Mr. ELLERY proposed a vote of thanks to the President. He said he felt sure that his proposition would be warmly received by the members after their three days' experience of Mr. Durkin's genial conduct in the chair. He did not remember a meeting which had passed off more successfully, for they had got through a great mass of business without a hitch; and they would look back to their visit to Southampton with a great deal of pleasure. The President must have been hard at work for some time past in preparing for the meeting; and they would all wish him to understand that they fully appreciated his exertions. It was not every year that they were honoured by being presided over by a gentleman who could boast of fifty years' service in one place. He had the pleasure of going over the gas-works, and could not help feeling that if, after this long service, he had to shoulder the responsibility which Mr. Durkin had in such a rapidly increasing town, he should not do it with the same look of youth which Mr. Durkin presented. He hoped he would be spared a great many years to continue the good work he was carrying on.

Mr. IRVING, in seconding the motion, said he could not but recognize how much of the success attending the meeting was due to the personality of the President. They were all aware what arduous and intricate negotiations had been going on, the success of which was due to a great extent to the masterly manner in which the President had conducted them. All his friends and neighbours in the south were proud of him.

The motion was carried by acclamation.

The PRESIDENT, in responding, thanked the members for the very kind way in which his name had been associated with the presidency during the past year. Sometimes it had been hard work, he would admit; but he had had very able help right and left, which had made matters much easier than they would otherwise have been. He was determined that if the Institute came to Southampton they should not forget it; and this added to the seriousness of the position. It had been a labour of love. He had rejoiced at meeting so many old friends; and he thanked them very heartily for the cordial way in which the motion had been received. It was not to be expected that he could do another fifty years; but, whatever time remained to him, he should always try to do his duty, whether in connection with the Institute or other matters.

A vote of thanks having been passed to the Honorary Auditors,

The PRESIDENT proposed a vote of thanks to the Honorary Secretary (Mr. Davis)—a gentleman who, he said, did not spare himself in any way; and he thought they were indebted to him in a very great measure for the arrangements of the last three days.

Mr. W. S. HADDOCK (Warrington) seconded the motion which was carried unanimously.

Mr. DAVIS, in reply, thanked the members for their compliment, and for their renewed confidence in him by his re-election as Honorary Secretary. He must say that the principal part of the work was done by the permanent Secretary, Mr. Dunn; and the success of the meeting was principally owing to his efforts.

The PRESIDENT then moved a vote of thanks to Mr. Dunn, whom, he said, they must not forget, though he was a salaried officer. He was most painstaking and attentive to the smallest detail of his duties, and they were much indebted to him.

Mr. PATERSON seconded the motion, which was carried unanimously.

Mr. DUNN having briefly acknowledged the vote, the proceedings closed.

THE LECTURE.

THE ELECTROLYSIS OF GAS-MAINS.

By James Swinburne, M.Inst.C.E.

Argument. Tramways and Telephones. Cross's Committee. Parliament onsidered forbidding earthed returns greater hardship to tramway industry than chance of electrolysis to pipe companies. Should tramways be liable for damages due to electrolysis. Little definite information as to real damage by electrolysis available. Explanation of anode and cathode. Corrosion at anode only. Methods of minimising corrosion. Measures to be taken by pipe companies. American electrolysis. Natural earth currents.

About ten years ago there was a good deal of friendly friction between the National Telephone Company and the electrical traction industry. Electrical traction was just beginning to develop in this country at that date; and electrical engineers were promoting Electric Tramway Bills in Parliament. The telephone people complained that the leakage, or stray currents, from the tramways disturbed their telephone systems; and they asked for protective clauses. In some cases such clauses were inserted; in others the telephone people failed. In one case the Committee, in their anxiety to be quite fair, ruled not only that the tramway must not disturb the telephones, but the telephones should not disturb the tramway. The whole question became very acute when the National Telephone Company sued Graff Baker and the Leeds Tramway Company for disturbing their circuits in Leeds. This action was heard by Mr. Justice Kekewich, who decided that the Telephone Company could get no damages, because the tramway people worked under an Act of Parliament, and were not negligent, but were doing the best they could in reason.

A Joint Committee of both Houses of Parliament was soon appointed to go into the whole question. This Committee discussed the telephone question very fully, and finally decided broadly that, as the telephone circuits could be easily protected by doubling, instead of using earth-returns, and that as they were adopting this metallic return anyhow, because it gives a better service, they should not have the protection they sought. The Gas and Water Companies, however, also appeared in this inquiry; and this was practically the opening of a question which has awaited satisfactory settlement for the last decade. This Committee—generally known for short as Lord Cross's Committee—decided that uninsulated returns are permissible, and that preventing their use would throttle the industry. But they also decided that the tramway people should take all reasonable precautions in building and working their undertaking, so as not injuriously to affect by fusion or electrolytic action, any gas or water pipes.

Since this recommendation, there has been little done by the Gas and Water Companies until recently. Electrical tramways are now being put down on such a large scale that the owners of underground pipes are beginning naturally to regard the whole question as being very serious. When we consider the capital value of the buried pipes in this country alone (which must run into very many millions of money), it is clear that the question whether they will be eaten into holes and destroyed by tramways, without means of prevention or redress, is of enormous importance.

The first question was whether the tramways should be allowed to have leakage currents at all. Parliament practically decided that as it was a very great convenience to tramways to have what is called an earth-return, and as the corresponding harm to other people was only small, they should be allowed to have earth-returns—that is to say the Gas, Water, and Telephone Companies are not to have immunity. The Telephone Company is not on all-fours with Gas and Water Companies, as the National Telephone Company was not incorporated by Act of Parliament.

During last session the controversy between the tramways and the Gas and Water Companies was substantially that the tramway people said they caused no damage to the pipes, or none that would ever be perceptible; and Parliament had already decided that they should be allowed to use earth-returns. The pipe-owners said: "We do not want to stop your use of the earth-return. You say it does us no harm. We do not know whether it does or not; but we fear that it may. We, therefore, ask you to be liable for damages if you eat our pipes. If you do not eat them, such a protection, while satisfying our fears does you no harm; and if you do destroy our property, it is only fair that you should indemnify us." The tramways said: "We will not hurt your pipes; and it is unfair that if your pipes are naturally corroded, or are corroded by some other tramway people, we should have to pay. For, however, carefully we guard against leaks, we may at any time be made liable by the mistake of an arbitrator for a fabulous sum, without having done any harm to you at all." The Tramway Companies also argued that they worked under the Board of Trade regulations, and that the Board of Trade regulations were designed to prevent corrosion of pipes, and were amply strict enough for the purpose. The pipe-owners urged that there was always electrolysis; and the Board of Trade merely reduced it as far as was consistent with the satisfactory working of the tramways, without by any means rendering the tramways innocuous. This we may discuss more fully later. Last session, the Gas and Water Companies on the whole failed to get even the smaller protection they asked for; and this session they have done but little towards getting the insertion of clauses in their favour. Such is very shortly the history of the question.

When I was asked to give a lecture on this subject, I was very undecided as to what sort of paper I had better give. I might give an elementary treatise on electricity, with more special reference to electrolysis, or I might give a lecture full of experiments. Or I might have drawn awe-inspiring pictures of the future of your distribution systems, when all the iron of your pipes had been eaten away, and the gas merely ran along the tunnels left in the ground. Or I might have urged the tramway point of view, that the electrolysis is very minute, and what there is is rather good for the pipes, being a pleasant stimulant. An experimental lecture appeals to those present, and is, no doubt, more interesting in a way; but I felt that I had been honoured by being asked to deal with a subject which is of enormous importance to your industry, and therefore concerned many people who would be outside this lecture-room.* I therefore concluded that you would probably prefer me to deal with the subject broadly, and try and give you as fair and full an idea as I can of the whole subject.

It is difficult, of course, to be impartial on such a matter as this; and you will no doubt regard me as being specially electrical. I am, however, also an old gas man, as I was for some time at the South Shields Gas Company's works, under Mr. Warner, whom you all know. In the various contentions I have appeared in the Law Courts, and in the Committee rooms, sometimes on the electrical side, and sometimes for the gas and water people. My views have thus been moderate, and I think fairly impartial; and I will do my best to be impartial in this lecture.

But by far the greatest difficulty is to give any real information as to the true effect of the earth-currents from tramways. The question from the technical or scientific side is very obscure. If pipes are being corroded—even if the corrosion goes on to a very serious extent—it may not show for a long time. In fact, corrosion would only show when considerable damage had been done, unless a pipe company happened to examine a pipe which was specially strongly affected. The only thing is for me to give as much information as I can.

Electrolysis, or electric separation, applies to electric separation of chemical compounds. The most familiar example is the electrolysis of water. If an electric current is caused in (say) acidulated water, the piece of metal which leads the electricity down is called the anode, or way down. The piece which leads the electricity up again is called the

* The lecture actually given was experimental and explanatory. As the same ecture does not both sound and read well, I practically prepared two.

cathode, or way up. The two pieces of metal are called electrodes, or electric ways. The liquid is called the electrolyte, or thing that can be separated electrically. Water, and solutions of salt are all electrolytes—that is to say, they are decomposed when there is an electric current, and a current cannot exist between metallic electrodes in an electrolyte without decomposition. The decomposition is strictly proportional to the current and the time. Thus when acidulated water is decomposed, the quantity of oxygen and hydrogen liberated depends on both the current and the time it is on. The unit of current is an ampère, and an ampère decomposes 0·3357 gramme of water per hour, yielding 0·0374 gramme of hydrogen and 0·2983 gramme of oxygen. If, instead of water, other substances are decomposed, the amounts liberated are proportional to the combining weights. If the electrodes are platinum, there is no corrosion, as the platinum does not easily form salts. Suppose, for instance the solution, instead of being acidulated water, is water containing common salt and other salts, and suppose iron electrodes are used, then the anode will be converted into ferrous chloride. Hydrogen will come off at the cathode, unless there is some metal that will deposit instead of it. Thus if we have copper electrodes in copper sulphate, copper will be eaten off the anode, forming copper sulphate, and copper will be deposited on the cathode, forming a fresh-coloured coating. This process is carried on on a huge scale in copper refining.

What we are concerned with is the corrosion of iron when used as an anode in the ground. In the ground in a town we may take it that the pipes are buried in earth or sand which is damp with salt, and other compounds of sodium, potassium, and ammonium. Iron has a very curious property. It is not attacked when it is used as an anode in an alkaline solution. In caustic soda, for instance, it is not touched. But this property is scarcely likely to help it in the ground; for even if the ground was slightly alkaline, an effect of the electrolysis is to render the region round the anode acid. The iron is thus attacked. If there is plenty of salt present, we get chloride of iron; but the chances are that the iron is converted into basic salts or oxides. It does not matter much to the pipe what it is converted into. No harm is done to the pipe where it forms a cathode; as the only thing that could happen would be that metal might be deposited. Iron could not be deposited under the circumstances; so that we need only consider the corrosion of the anode. As the combining weight of iron is 28, the consumption of iron per ampère is 0·00029035 gramme per second, or 20 lbs. a year.

It will be clear then, that a gas-pipe can only be corroded where it is acting as an anode—that is to say, where the electric current is leaving it, to pass into damp ground. There is no corrosion where the electricity enters the pipe, because it is a cathode there; and there is no corrosion where the electricity leaves, unless it passes into an electrolyte, such as damp earth. If the electricity is taken off by a metallic conductor, such as a wire (which is not an electrolyte), there is no corrosion.

We may now consider the electrical connections on a tramway system. In its simplest form, a tramway system consists of an electrical generator driven by power at the station. This is connected with an overhead wire, which is thus kept at an electrical pressure of 500 volts. Each car has a sort of fishing-rod with a little trolley wheel, which makes contact with the overhead wire, and connects to the motors. From the motors, the circuit is led to the wheels and thence to the rail. It is carried back to the station by the rails. The current that goes back to the generator is necessarily equal to the current that goes out. Electricity is not like gas; there is the return circuit which must carry the whole current. Any current that leaks away from the rails must either find its way back into the rails, or otherwise get back to the generator.

Whether the current will all go back by the rails, or will partly go by the earth depends upon the resistance of the paths. Iron as a substance has very little resistance compared with damp earth; but on the other hand the damp earth forms a very broad path—in other words, the cross section is very large. Again, the rails are not continuous; and the joints have more resistance than the rails. The result is that there is considerable straying from the rails. This is shown diagrammatically in fig. 1.

Here A is the generator; B is the overhead system at 500 volts; C is a car; and D is the return circuit. Some electricity leaves the rails, and returns towards the generator by the earth; and when it gets near the station it enters the rails again. The earth acts as a bye-pass. Electricians

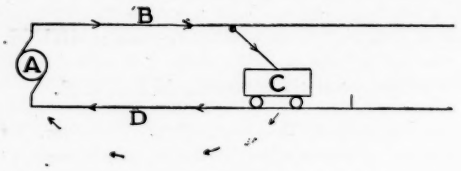


Fig. 1.

talk of leakage; but the analogy is the bye-pass. In fig. 2 is another elementary system with gas-pipes shown close to the rails. The gas-pipes are generally good conductors. Sometimes the joints do not make good electrical contact, and the resistance of the joints is high.

In fig. 2 the gas-pipe is shown as E. There is a current into the pipes at F, and out again at G. As has already been explained, the earth acts as a sort of bye-pass to D, and takes a share of the return current. The gas-pipe acts as a sort of second bye-pass—that is to say, a bye-pass to a bye-pass; and there is thus a small current in the pipe.

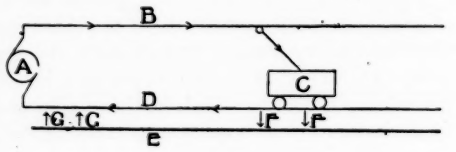


Fig. 2.

If the system is examined, it is seen that the rails have a fairly large current leaving them. The rails must be proportionately corroded at these regions. Then a portion of the leakage goes into the gas-pipe at F. This does no harm, as the pipes are cathode there. That is to say, the current into the metallic conductor does not corrode it. At G, however, the current leaves the pipe; so there is corrosion there. The electricity that leaves the pipe at G crosses through the earth to the rail, and thus to the generator. If, therefore, the pipe is connected by means of a wire to the return or negative end of the generator circuit, the electricity leaves the pipe by a metallic conductor, so that there is no corrosion. As will be seen presently, making metallic connection to the pipes in the neighbourhood of the station is one of the methods of minimizing the electrolytic corrosion.

We have mentioned electrical current, and electrical pressure, and referred to resistance and to conductors. It would be no use to try and give a clear explanation of what controls electric currents here, for time is too short. Many, probably most, of my hearers also understand the matter already. But it may be advisable to give those who have not studied electricity at least some idea of the relations of the electrical quantities we have most to deal with. The electrical current (ampères) is analogous to a current of water, a conductor corresponding roughly to a pipe. The resistance of the conductor (ohms) then corresponds with the friction of the pipe, due to its smallness of bore or to its internal roughness, and the electrical pressure (volts) to the pressure or head of water. But there is this difference; the relation between the flow of water and the pressure causing the flow in a pipe is complicated; but in electricity it is very simple. The current (in ampères) is proportional to the pressure (in volts) divided by the resistance (in ohms). In the case of electrolysis, there is often a back-pressure; for instance when water is electrolyzed into oxygen and hydrogen. But in the sort of electrolysis which we are discussing, there is generally no appreciable back-pressure. This is mentioned because it is sometimes said that electrolysis cannot take place unless there is over 1 volt of pressure available.

If we consider a track where the rails form the only return, if the current to be returned is large and the distance long, so that the resistance is considerable, we might have considerable pressure between the far-end of the rails and the station. In America, especially in the early days, they had very high pressures on the rails—sometimes 30 volts and upwards. Taking the earth itself generally as being at zero pressure, or, to use the water analogy, at zero level or

head, we may consider that one end of the rails would in the extreme case mentioned be 15 volts above the zero, and the other 15 volts below. With such a pressure as this, there would be considerable leakage, or bye-passage of current through the earth. Any pipes lying along the route would then pick up a portion of the stray current, and suffer corrosion where the electricity left it.

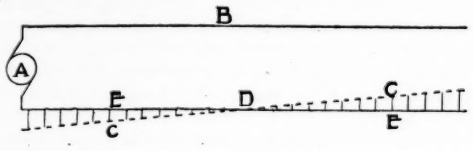


FIG. 3.

The variation of potential along the earthed return, supposing it to be uniform, is shown in fig. 3. Here E E is the return; and its potential with regard to the earth is given by the vertical distance between E E and the inclined line C C. At the far end, the rails are positive (this being shown by C being above E), and no corrosion of pipes will take place. But at the near end, they are negative. Between these two areas there is a spot D where the rails are at earth potential; and there is no tendency for electricity to pass to or from the pipes.

We may now consider the precautions and measures taken to minimize corrosion of pipes. The first thing is to keep the resistance of the return rails as low as possible. The resistance is chiefly at the joints; and it is difficult to make good contact by means of the fish-plates. The rails are therefore "bonded," or electrically joined by bonds of flexible copper. Sometimes, in order to make better joints the rails are electrically welded, or welded and cast by Goldschmidt's process, or joined by pouring fused iron round them from a portable cupola.

In a long line, or where the traffic, and therefore the return current, is large, no amount of bonding will do. The Board of Trade here come in with a regulation that a tramway must not spend more than 7 volts on its return rails. What are called "suckers" are therefore introduced. Fig. 4

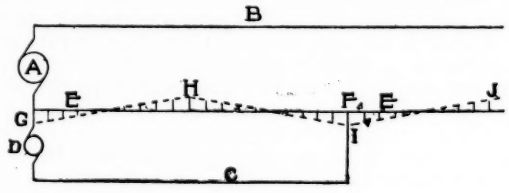


FIG. 4.

shows the system with suckers. The suckers are insulated conductors which draw off from various points of the system. They generally have what are called "negative boosters" in their circuits. A "booster" is a machine for adding a little pressure to a circuit; a negative booster subtracts pressure, or sucks. It is an electric motor, driving a generator; the generator being so arranged that it sucks in proportion to the current, so that the far end of the sucker, where it joins the rails, is kept at nearly zero pressure, or not more than $3\frac{1}{2}$ volts below it. Thus in fig. 4, an insulated conductor C is taken from the point F of the rails through a negative booster D to the generating station. The potential of the rails is represented by the line G H I J, which shows that some sections of the track are positive and some negative.

The rails are insulated to some extent (incidentally) by being embedded in concrete, which is a very bad conductor when dry, but according to many measurements conducts well when wet. It might be worth while to saturate it with some waxy, tarry, or greasy material when quite dry. Tarring the rails, or coating them, does not insulate them permanently. A layer of asphalt keeps the ground under it dry and so increases the resistance.

The Board of Trade regulations do more than limit the difference between different parts of the earthed system. They provide that, with earth plates at the station at least 20 yards apart, with not more than 1 ohm resistance to earth in parallel, these plates shall only collect 2 ampères per mile of tramway, or 5 per cent. of the total current. Any rails must not be more than $4\frac{1}{2}$ volts above any neighbouring pipes or $1\frac{1}{2}$ volts below them. These pressures are determined with Leclanché cells. They make various other minor regulations.

Sometimes, instead of using suckers, the flow of electricity is helped along the rails, as it were, by what we may call "helpers" or "helpers home." These are "boosters" arranged in the rail-circuits so as to help the flow, as it were. Thus, suppose the engineer decided to keep within a limit of 4 volts maximum difference of pressure in his rails. At maximum load, a length of rails might have 4 volts drop of pressure, from + 2 volts to − 2 volts; the middle being at zero or earth pressure. At the − 2 point, the rail would be severed and the electric circuit led through a conductor to a booster, which would add 4 volts, and return it to the next section at + 2 volts. The system is shown in fig. 5, in which

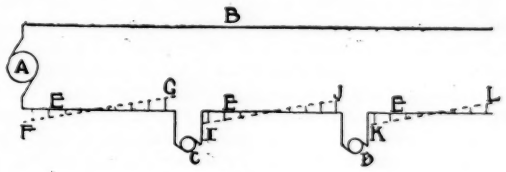


FIG. 5.

C and D are the boosters inserted in the rail-circuit E. The potential of each of the sections varies from positive to negative, as shown by the inclined lines F G, I J, and K L. Helpers are not used, as far as I know; but the idea, though old, has been recently revived.

Little or nothing more can be done to protect the pipes by dealing with the return-rail track. Something can, however, be done to the pipes. As has been explained, it is not the entry of the electricity into the pipes that does the harm; it is where the electricity leaves the metal and goes into the damp earth—that is to say, where the pipe is acting as anode. If all the parts of the pipe that might act as anode are connected by wires to the rails, or to the station, so that the electricity can be carried off without passing into an electrolyte, there is no electrolysis, and the pipes are safe. The region round the station is clearly that where the pipes may be anodes. This region is therefore often known as the "danger area;" and if metallic connection is made from the negative terminal of the station to the pipes in the danger area, the pipes are safe. This increases the current in the pipes; but that does not matter to the pipes unless there are joints which cause the electricity to pass round by the earth. The increase of current means increase of corrosion of the train-rails; but that is clearly the tramway peoples' look-out. When suckers are used, they are arranged so that they reduce the pressure of the rails where they join below the earth, so that the rails are then negative to the earth. They therefore make local danger areas. The pipes should thus, where possible, be connected to the rails there.

We have now mentioned practically all the methods known of keeping down the chances of electrolysis by designing the tramway to produce as little effect as possible. We have, of course, only dealt with the overhead single-trolley system, which is universally used in this country. One cure is to depart from the system altogether. For instance, we might have both conductors overhead. This would get rid of electrolysis altogether; but the method is so inconvenient, so costly, and so unsightly, that it is almost out of the question. Unless there were much stronger evidences of real damage from electrolysis than any we have so far, Parliament would never put such a thing on tramway companies. The double trolley has been used in one or two places; but the results are not encouraging. Some of the conduit or culvert systems, in which the electric conductors are in a sort of long nearly closed conduit, with a narrow slit along the top, have both conductors insulated; but this give rise to difficulties at crossings and turn-outs. Surface-contact systems can also be designed to have no earthed conductors; but in their case also it is very much more difficult to insulate both conductors.

The precautions in design and working which can be taken by the tramway engineers are thus:

(*a*) Good bonding of rails, and rails of large section.

(*b*) Suckers to the rails from the power-houses.

(*c*) Insulation of rails by concrete, and so on.

(*d*) Inserting "helpers" in the rail-circuits.

There is still another system which has not received the

attention at the hands of electrical engineers that I would suggest it deserves—that is, the "three-wire" system. Along one line the overhead wire is at a pressure of 500 volts; along the other it is negative, at − 500 volts. The circuit is then, not from the rails to the power-house, but merely across to the other rails and home by the next tram-car and the − 500 volt overhead wires. The system is more complicated; and there are 1000 volts between neighbouring overhead wires, as well as the usual 500 between one and the earth. There is also difficulty in balancing so that there is approximately the same current on each side. Connections from the rails to the power-house are still necessary; but they are smaller and much less numerous for a given area.

We may now consider what the gas and water companies can do to protect their pipes. Throughout the danger area, they should be metallically connected with the power-house, or the suckers. Coating with Angus Smith's composition, or asphalt, tar, and the like, is proved to give little or no protection. It is found that wrought-iron pipes are corroded more quickly than cast, especially close-grained cast iron. In this country wrought iron is only used for service-pipes, as far as I know. It would be an advantage to destroy the electrical continuity of pipes by occasionally packing joints with sulphur, sulphide of iron, or something other than lead. Lead does not make a good electrical joint. Pouring lead round does not remove the bituminous coating of the pipes. Lead also soon coats itself with insulating compounds such as hydrated oxide, which prevents its making good electrical contact. This should be done, especially in places where the ground happens to be dry and well drained. It has been proposed to adopt earthenware or stoneware pipes. Such schemes are of little value. The pipes are already down, and, generally speaking, will remain down unless something serious happens to them.

The insulation of occasional joints in water-pipes would also be of advantage. It might be supposed that this would do little, because the water conducts, and would therefore make a passage round the insulated joint. The water supplied to houses is, however, such a very poor conductor, that the current carried by it may be neglected. Insulating the joints in this way may, however, sometimes do harm. For instance, suppose a line of pipe is carrying a current which is taken to the power-house by a metallic wire connected to it for the purpose, the pipe might have no current leaving it, and therefore no corrosion. If the pipe is insulated at a joint, it will introduce a local resistance; and the electricity will leave the pipe and go into the earth close to the joint, entering the pipe again a little further on. One side of the joint thus become anode with corrosion, while the other becomes cathode, which does not matter. Insulating joints does not therefore necessarily help. It reduces the current, but at the expense of local corrosion, unless the joint is in very dry ground. If joints are insulated at very frequent intervals, the pipe will be so discontinuous as a conductor that it will pick up no appreciable current. Insulation of joints is therefore a good measure when taken judiciously; but it is not always possible, as a company cannot well open up the roads on purpose to break the joints and recaulk the mains.

In America, it has been proposed to make gas and water pipes of stoneware. Such pipes could, of course, be made; and in some ways it might be easier to render them gas-tight. They might also be made strong enough to stand a steam-roller without being buried very deep. But any change of that sort cannot be considered seriously in this country except for new mains.

Practically the only thing the pipe-owning companies can do to safeguard themselves, or to lessen the effects of stray currents, is to insert insulating joints at intervals where possible, and to connect the pipes metallically with the power-house, or the rails in danger areas—that is to say, in areas where the pipes are apt to be anodes.

Cast-iron pipes are sometimes joined up with wrought-iron or lead service pipes, often with brass couplings. Such metals in damp soil set up local currents of their own, which eat the lead or wrought iron apart altogether from any tramways.

The next, and perhaps the most important question is: How much damage are electrical tramway systems doing now, and how much will they do in the future? We hear a great deal about the damage done in the United States; and there is no doubt that there has been a great deal of trouble there. The statements in the Technical Press are exceedingly difficult to deal with. There is strong partisanship, and great exaggeration. In addition, many of those dealing with the matter have very inaccurate notions about electrolysis.

The conditions in America are different, but especially they have been different. Damage by electrolysis is essentially a matter of time; and the corrosions that are now making themselves evident in America are the results of past working. Electrical tramways have been in extensive use there for some twelve years; and it might appear that the present state of the pipes show us what to expect here in ten years or so. This, however, is not so. In America, especially in the early days of tramways, the rails were of small section; and they were very badly bonded. They were largely laid in mud, which forms the bed of many American roads. But, more than all this, they frequently allowed 30 volts in the rails, or three times our permissible maximum.

We have developed electrical tramways slowly in this country. One result of our British way of doing things is that we now put our tramways down well. The Board of Trade also limit the pressure allowed between points in the rails; and the tramway engineers generally keep very much within this limit, for their own sakes. It must be remembered that the tramway people do not want to eat pipes. They may be made liable for damages some day or other if they do.

But there is another point. Any stray electricity that gets into pipes must have left the rails, and must have corroded them proportionately. But the current in the pipes is only a fraction, generally a very small fraction, of the whole stray current; so that if there is corrosion of pipes, there is very much greater corresponding corrosion of the tramway rails. In their own interests, therefore, electrical engineers keep the stray currents down as low as they possibly can. Of course, if a considerable part of the stray current goes along a pipe, and frequently leaves it to go round an insulated joint, returning to it after the joint, there is corrosion wherever it leaves the metal. If there are many such joints, the total corrosion of the pipes may be comparable with that of the rails, or even greater, though the current from the rails is greater than that in the pipes. But the frequency of such insulated joints in practice sends the resistance up, so that there is then comparatively little current in the pipe-circuit.

The most remarkable fact about electrolytic corrosion is that it is clearly not so great as might be expected. It has even been said that the earth conducts like metals, non-electrolytically, so that electricity can leave rails or pipes and go into the earth without the corresponding corrosion. This theory is far too good to be true. The components of the soil are mostly insulators in themselves. Such substances as silica (sand), and the various silicates of which clays are composed, and chalk, are all insulators; and the conduction is due not to them, but to the salts dissolved in the water that moistens them. No transparent body can conduct otherwise than electrolytically. This theory appears to me, for one, quite untenable.

It is much more probable that, in estimating the corrosion of pipes, people are apt to over-estimate the difference of electrical pressure between points in the earth. Take a simple case of a long straight single rail on the surface of comparatively badly conducting earth. Suppose that it is at 2 volts above the ground in pressure. The ground just in contact with the rail will be raised to 2 volts. The earth a long way from it, on the other hand, will be at zero pressure, if not disturbed by some other source of electrical pressure. There is thus a gradual fall of from 2 volts to zero as the distance from the rail increases. But the rate of decrease of pressure is much greater close to the rail than far off it—in fact, the rate at which the pressure will decrease is approximately inversely proportional to the distance. The result of this is that the pressure falls quickly as the distance from the rail increases. Another way of putting it is that the earth itself in the more immediate neighbourhood of the rail acts as a sort of coating; the 2 volts being nearly all spent on it. The pressure of the earth a short distance from the rail will thus be very little above zero.

If a good conductor, such as a pipe with electrically conducting joints, were laid in earth which was 2 volts above zero pressure, and if the pipe were kept at zero pressure by being connected to a power-house, or by going into a region where the earth was at (say) 2 volts, it would, if of equivalent size and shape, pick up a current equal to that leaked by the rail already discussed. But if it is laid in a region at a minute fraction of a volt above the normal, it

will only pick up a corresponding current. One of the few papers which gives definite information in a useful form is by Larsen & Faber.* These observers measured the currents in pipes following the tracks, and found values which are serious. These observations go to show that pipes close to lines with large pressure drops, will, if not protected by metallic connections, be seriously corroded in course of time.

It is probable, in spite of this special case, that pipes pick up much more minute currents than is generally believed. Another reason for supposing that the pipes do not take up very large currents, is that there are earth currents due to natural causes. Now earth currents would cause electrolysis just as much as stray tramway currents. But pipes have been in the ground for not very far off a century; and pipes fifty years old are often found to be as good as new. Yet the earth currents have been going on all the time. Unfortunately, we have few useful data about earth currents. What we want to know is the differences of electrical pressure between one region and another. The observations are made by the telegraph authorities; and they have nearly always given their results in terms of the current in their wires. They have given these without stating their resistances, so that their figures are useless. A book by an eminent German professor has recently been published furnishing figures involving an enormous amount of work. They deal with Germany, but convey no information, because the data which would make them valuable have been inadvertently dropped out.

Fortunately a few telegraphists, instead of reading the deflections of a galvanometer, have tried how many telegraph battery cells had to be put in to reverse the current; and from this we can get a rough idea of the differences of pressure between different regions. I may mention that Varley once found between London and Ipswich a difference of pressure of about 140 volts, or 2¾ volts fall of pressure per mile. Such pressures are variable; but they are comparable with the disturbances due to electrical tramways.

I have measured the currents in pipes where there are no tramways within many miles, and found them comparable with those found near working tramways. Yet they do not seem to do so very much harm. It is possible that all corrosion of pipes, apart altogether from tramways, is produced by, or accompanied by, electrolysis. Dissolved oxygen, or oxidizing solutions in the earth, would attack iron without electrolysis; but it is doubtful if the moisture in the earth contains such matters. The decaying vegetable matter and humus, and in towns the decaying animal matter, would all be reducing agents, and prevent direct oxidation of iron.

Though what I have been saying may tend to allay fears as to the ravages of electrolysis, I certainly do not mean to say tramways will do pipes no harm. They certainly will do them no good. The question is: How much harm will they do? Electrolysis involves damage of the most insidious kind. It means a gradual corrosion of pipes until they either break or develop leaks in all sorts of unexpected places. Whether it will really damage the property of gas companies to a serious extent, I for one cannot say. It is a matter of time.

The best thing gas and water companies can do is to watch their pipes carefully, inspecting them whenever they are open for other purposes. When the road is opened and a pipe uncovered, it would be as well to measure the electrical current in it. It is quite easy to measure the current in a pipe. The fall of pressure over a given length, excluding any joints, can be taken with a sensitive galvanometer. The resistance can be calculated, or else found by measuring a similar pipe. From these data the current is got. By including a joint, the resistance of the joint can be found. The measurements of current should be taken day and night, to see if the current is due to tramways.

Another measurement that is important is the relative pressure of the pipe and neighbouring earth. If the pipe is positive to the neighbouring earth, it is acting as an anode, and is therefore being corroded, and ought to be metallically connected with the power-house. If the pipe companies cannot get legal protection, the best thing they can do is to make friends with the tramway people. Where the electrical tramways and the gas and water are owned by a local authority, there ought to be no difficulty; but even otherwise the electrical company and the pipe-owners would do well to work together. To make these electrical tests involves some electrical knowledge; and gas and water companies do not want to employ electricians on their staffs. The tramway people could generally make these tests for them without any great difficulty, and arrange experiments with them.

As to what the right course for Parliament to take may be, there is much to say on both sides. On one side it would not do to veto earthed returns, because this would throttle an industry. It is quite certain it would injure the tramway industry enormously to forbid earth returns. This means depriving the public of means of locomotion; and depriving the tramway shareholders of profits. The tramway shareholders are part of the public, and have a right to be considered. So are the gas and water companies, and their shareholders. In addition, they were there first. But the evil of vetoing earthed returns is serious and certain, while the evils of electrolysis are comparatively remote, and uncertain. So, taking industry broadly, Parliament has so far decided to allow earthed returns.

The next question is as to whether pipe companies should have damages if their pipes are eaten. This seems obviously fair. But there is very serious difficulty in carrying such protection clauses into effect. A gas company find their pipes eaten in one district. The first thing is to prove the corrosion is electrolytic, and not due to natural causes. This is in itself not necessarily easy. Suppose it is clear that the failure is due to electrolysis, the electrolysis may be due to natural earth currents. If not, and it is due to an electrical system, who is to say which system? In small towns where there is only one tramway system, the chance of appreciable electrolysis is small. In large towns there are, or soon will be, several tramway systems, and probably some electrical railways. It would be very difficult for a London Company to decide who ate their pipes, and still more difficult to bring the crime home by the clumsy and expensive method of arbitration.

To make the tramway people liable for any damages is obviously fair; the real difficulty is to carry the matter out. Such a liability is for that reason very serious to the tramway. A small tramway—which we will for this example suppose really innocent—is liable to be mulcted in damages that might ruin it, by a mistake of judgment of an arbitrator, or of experts called before him. This is a very serious liability.

To sum up, there is electrolysis, and your pipes are being eaten; but whether or not the corrosion is really serious, can hardly be settled yet. Tramways are increasing in all directions; but they are also being more and more carefully designed. The large systems use lead-covered cables themselves, which are infinitely more easily damaged by electrolysis than gas-pipes, because the lead is easily corroded, the conductors are continuous, and the cables are generally near the tram-lines. The electrical tramways are thus more likely to damage themselves than their neighbours by any bad design or careless working. It behoves gas and water companies, however, to watch carefully. The question of electrolysis is not really settled. In the course of years we may have more information; and we may then find either that the stray currents are practically harmless, or that new laws have to be made.

The PRESIDENT remarked that Mr. Swinburne had made several matters much clearer to his mind than they were before; and he had no doubt it was the same with many others. They could only trust that with more knowledge of these underground arrangements they would be able to protect their property more efficiently. They would all wish Mr. Swinburne every success in his year of office in connection with the Institution of Electrical Engineers.

Mr. C. STAFFORD ELLERY (Bath) said it gave him much pleasure to propose a vote of thanks to Mr. Swinburne. This was the first time the Gas Institute had had the pleasure of welcoming at their meeting the President of a friendly rival. He (Mr. Ellery) had been trying to picture the President of the Gas Institute going to deliver a lecture to the Electrical Engineers, and had been wondering what he would have to say to them. He hoped he would be able to carry more comfort to them than he confessed he had been able to derive from the very interesting and charming lecture just delivered. He (Mr. Ellery) had been listening throughout for some crumbs of comfort; but he was bound to say he had not found them. Notwithstanding that, it had been interesting

* "Elektrotechnische Zeitschrift," 22, pp. 1038-1043. Dec. 19, 1901.

to the highest degree. Mr. Swinburne said electrical terms were beautifully simple. This was the first time he (Mr. Ellery) had heard such a statement. It was true the matter had been expounded by a master of the art, who had made the lecture beautifully simple. But some of them who had been trying to compare electrical values with gas values, had not found, as a rule, that electrical terms were such as they had been described. He wished the lecture could have embraced some information such as they were constantly asking for, with regard to electric lighting as well as electrolysis. He might express the hope, in which he thought Mr. Swinburne would join, that the ghastly specimens they had seen were going to be very exceptional, and that, with electrical engineers and gas managers working harmoniously, with one end in view, they would be able to meet the difficulty. They might hope that some means would be devised for disposing of what looked as if it would become a very serious matter; or, at any rate, that the danger might be minimized, as the outcome of the scientific work which was going on.

Mr. D. Irving (Bristol) expressed his great pleasure in seconding the vote of thanks. He said they had been assured by Mr. Swinburne that leakage of current was always taking place to a greater or less degree, and that, this being the case, the destruction or electrolysis of gas and water mains must always be going on. Whether or not it was really a serious matter, it was difficult to say; but the apprehension on the part of their electrical friends as to being saddled with the responsibility for any such destruction proved that there was something serious to be feared. They had combined in a very energetic way to avoid, in every case before Committees of the House of Commons, being saddled with the responsibility for any leakages which might take place from their cables. If there were no serious damage likely to be done, why did they fear it so much? As far as gas companies were concerned, they desired to work on the most amicable terms possible with their friends the electricians. In Bristol, there were two large and successful electricity supply undertakings—one devoted to lighting and the other to traction. It was necessary that they should work together as far as possible; but, generally speaking, according to his experience, the electric people were very secretive as to their own transactions. Some small matters had occurred in the Bristol district, and they had never been able to arrive at the cause of certain little accidents and fusion of pipes which had taken place, simply because neither the Water nor the Gas Company was armed with a technical staff to keep a check upon these things. He desired to express his thanks to Mr. Swinburne, not only for his lecture, but for coming among them, as President of the Institution of Electrical Engineers, and setting an example of the co-operation which he had suggested.

The President said Mr. Swinburne would be pleased to answer any questions which members desired to put.

Mr. W. W. Hutchinson (Barnsley) asked what would be the best precautions to adopt, to prevent damage, with regard to a gas-main going over a canal bridge within 3 feet of a tramway which was about to be laid down. It was an 18-inch pipe, running parallel with the tram-lines.

Mr. Swinburne said that the mere fact of going over a bridge made no difference. It was parallel to the case of a main running along a street. It depended on which way the electric current was going—whether into the pipe or out of it. The only thing he could recommend would be to connect the pipe to the rails; but this would depend upon where it was on the electric system. He could not answer definitely without knowing all the circumstances.

Mr. Hutchinson said it was about three-quarters of a mile from the central station.

Mr. Swinburne said he should advise Mr. Hutchinson to ask the people at the station which way the current was going, and whether the pipes were likely to be cathodes or anodes. In the one case, they should be connected metallically; in the other, they should simply be left alone.

The President then put the motion, and it was carried unanimously.

Mr. Swinburne, in acknowledging the vote, said he would not detain the meeting by any formal speech, but he thanked them very cordially for their kind reception. He was an old gas man himself, having been connected with the gas industry before taking up with electric lighting. He was sure the Institution of Electrical Engineers would be only too delighted if the President of the Gas Institute would come and give them a lecture.

PAPERS READ.

THE STEAM-TURBINE AS APPLIED TO BLOWING AND EXHAUSTING APPARATUS.

By W. D. Child, of Romford.

During the year 1901, I was engaged in putting down plant for the manufacture of carburetted water gas; and when designing the building for its reception, I arranged for the engine-room (in which the blowing fans and the exhausters were to be placed) to be on the same level as the operating floor of the gas plant, in order that the whole of the apparatus might be under the eye, and within easy reach, of the gas maker. Under the arrangement described, the engine-room floors were considerably above the ground level, and were constructed with steel joists and portland cement concrete. This portion of the work was commenced before the contract for the gas plant was placed, and when, at a later date, discussing the details of the arrangement with the Contractors (Messrs. Humphreys and Glasgow) some doubt was expressed as to the stability of the floors and the wall of an old building which formed one side of the engine-room—not as to their weight carrying capacity, but whether they would withstand the vibration set up by reciprocating engines when driving belting, pulleys, and countershafting, all running at the high speed required for effective work with blowing plant when being used for gas-making purposes.

Carburetted water gas practice requires the use of large volumes of air at high pressures for the purpose of quickly raising the temperature of the fuel in the generator and other parts of the plant; and this pressure, equal to a column of water about 20 inches in height, is obtained by the running of centrifugal fans. The pressure obtainable from centrifugal fans is dependent upon the peripheral velocity of the fan-blades, and, consequently, upon the tip to tip diameter of the same, and the number of revolutions run per minute. Usual carburetted water-gas practice requires a peripheral velocity of about 17,000 feet per minute, which means, with fans of practicable dimensions, a speed of 1500 to 3000 revolutions per minute.

Most steam-engines can only run from 150 to 500 revolutions per minute; and therefore belt gearing is usually required, and frequently countershafting as well, to attain the rapidity of motion necessary for the fans. The many disadvantages attendant upon obtaining high rates of speed by these means are well known. Great weight is required in the construction of engines and buildings in order that the inertia so obtained may resist the excessive vibration set up by the straining, jarring, and friction caused by inequalities in the belting moving round pulleys running at rapid rates. The noise so produced is also most objectionable, and considerable uncertainty prevails, arising from the probability of an occasional slipping of a driving belt, which may occur at some critical moment in the manufacture of the gas, and result in an explosion in the plant; while the risk of accident to the person necessitates great precautions being taken to guard against the clothing of attendants or others being inadvertently caught in the rapidly moving belting. Considerable space is also a requisite, as if the belting is too short, it must be proportionately tight, producing great side-stress upon the shafting and bearings, resulting in enormous friction and the rapid deterioration of the belt itself.

In endeavouring to secure the best arrangement of engine power and machinery that could be made for the rooms already partially constructed, and in devising the soundest method of strengthening the walls of the building by stancheons, so that the strain of the countershafting would be suitably provided for, the various disadvantages I have mentioned severally presented themselves to me. Having in my mind a recollection of some rotary engines (Hodgson's high-speed expansive rotary engines) which were on show at the Crystal Palace at the time of the Gas and Electric Exhibition in 1883, I expressed regret that this type of engine had not been more fully developed and utilized. The specification provided for horizontal engines, countershaft, and belting; but on hearing my suggestion, the Contractors at once offered to substitute steam-turbines coupled direct to the blowers, with a guarantee that if they proved unsatisfactory, they would, at their own expense, remove and replace them with the engines, &c., as specified.

The apparatus selected for use was the De Laval steam turbine; and the installation, besides being novel, has proved so satisfactory, and apparently possesses so many advantages, that I willingly acceded to a request from the Hon. Secretary of the Institute to introduce the subject to the members at this meeting.

The principal advantages claimed by the makers for the De Laval steam turbine are: Small space occupied, perfect balance, small foundations, simplicity of construction, ease of erection, close speed regulation, no leakage from wear, small friction loss, high efficiency with variable loads, no moving parts under steam pressure, automatic oiling, no danger from water, and long life. After an acquaintance of six months with these engines, I can say that these several points are fully maintained.

Having explained the reasons that led to the adoption of this new type of motor, I will proceed with a description of its construction and action as compared with the steam-engines ordinarily in use. The movement produced by the steam-engine is a reciprocating one; and to transmit to machinery the power so produced, it is found convenient to convert the reciprocating action to a rotary motion, which is accomplished by means of a crank. This alteration of action, even in the best balanced engines, results in a considerable amount of vibration, and also of friction. The former being caused by the continuously alternating movement of the piston and connecting rods, and the latter by the weight and surface of bearings and couplings necessary to resist the shock of the constant alteration of direction of the moving parts of the machinery, as well as the pressure of the tightly packed glands required to prevent escape of steam promoted by the alternating action of the slide rods.

Upon the frequent and careful attention to the repacking of the glands in which the slide rods and connecting rods work, and also the adjustment of bearings and couplings, the life and economy of an engine greatly depend; and this attention occupies a considerable amount of time. It is therefore gratifying to know that the disadvantages I have mentioned may be overcome, and high speeds readily attained, by the use of the De Laval steam turbine.

The turbine principle of construction appears to have been the earliest form of the application of steam as a motive power. In a work entitled "Spiritalia seu Pneumatica," it is recorded that Hero, of Alexandria, contrived a machine 120 years before the Christian era, which was moved by the force of mechanical vapour. This was in reality a turbine of the reaction type. In 1629, Giovanni Branca, of Loretto, in Italy, introduced the turbine of the impact type, and proposed to drive mills by the force of steam issuing from a large æolopile. This engine consisted of a wheel furnished with flat vanes; and the steam was made to issue with violence from the end of a pipe directed against the vanes, causing the wheel to revolve. That the steam-turbine, which now rivals the steam-engine, should have been known at such an early date, and yet should have been so long delayed in arriving at its present perfection in a practical form, may seem astonishing. This, however, is not remarkable; for even if the high efficiency of the turbine had been realized by Hero and Branca and others of early times, a practical machine could not have been produced for want of material and tools of such refinement and quality as we to-day know are as essential to the construction of a successful steam-turbine as are the principles involved.

The construction of steam-turbines in the form that has met with so much success, is the outcome of experiments made with a view to obtain a direct acting rotary engine. In 1883, De Laval made his first successful turbine for the direct driving of cream separators, which machines require a relatively high speed. The first turbines were of the reaction type, and were of the same design and principle as the Scotch water-turbine. The turbine wheel was made as a pipe bent in S form; and the steam was supplied to the wheel through a stuffing-box on the extension of the turbine shaft. The wheel was mounted direct on the shaft of the separator bowl, and the turbine was enclosed in the stand of the separator.

This construction of turbine was found unsuitable for continuous working and for high efficiency; and the design of the reaction wheel was replaced by the impact or Branca type. The result was an astonishing efficiency—in many cases of good design—and, as constructed by De Laval, exhibited such satisfactory qualities as to make it a permanent and standard addition to the list of prime movers. The steam consumption, however, was far too high; for the reason that the steam does not work expansively in the machine. This wasteful method De Laval overcame by a new form of wheel, and by the use of the diverging nozzle, by which he obtained complete and adiabatic expansion of the steam, and the conversion of its entire static into kinetic energy.

The De Laval steam-turbine in its most recent form is characterized by the simplicity of its construction and the directness of its energy conversion, producing adiabatic and complete expansion—ideal conditions which cannot be attained with the steam-engine, for the reason that the cylinder condensation would be too high, and the dimensions of the machine too large. The principle of the De Laval turbine is to take up the kinetic energy of a steam jet in the buckets of a turbine wheel against which the steam is blown, thereby imparting a rotary motion, and delivering most of its energy to the rotating wheel. The steam acts by its speed and mass, and before entering the buckets has already been converted to the same pressure as exists in the chamber in which the wheel rotates. To accomplish this, the high-pressure steam, after it has passed through the governor D (fig. 1), enters the steam-chamber E, where it is distributed to the steam-nozzles I (fig. 2). These, according to the size of the machine, range in number from 1 to 12. They are fitted with shut-off valves, by means of which one or more nozzles may be cut out when the turbine is not loaded to its full capacity.

This arrangement of utilizing the number of nozzles in proportion to the work to be performed, allows steam of high boiler pressure to be always used, and adds to the economy on light loads. It also makes it unnecessary for the governor valve to throttle the pressure of the entering steam to any considerable degree. The high speed of the steam is obtained by expanding it; and this expansion takes place in the diverging nozzles. The passage of the nozzles is made conical. This form of construction causes the steam to expand as it passes through the passages, and the work of expansion imparts a very high velocity to the steam as it leaves the nozzles. In a properly constructed nozzle, a volume of steam enters at I gradually; and as every element of the nozzle assumes a temperature constant and equal to that of the passing steam, it adiabatically expands to minimum pressure; and as this pressure is that of the surrounding medium, the steam at the point of discharge issues in a solid jet without tendency of its particles to divert in any direction.

Professor Zeuner has made extensive tests of the velocity of outflow steam when it passes the nozzles, and has given data from which the form of passage may be exactly calculated. He has also proved that in a nozzle of correct dimensions the static energy of the steam is transferred into kinetic energy, and that this latter is identical with the quantity of work the same steam should perform if it were expanded in the cylinder of a steam-engine to the pressure of exhaust steam.

Table of the Velocity of Outflow and the Working Capacity of Dry Saturated Steam.

Initial Steam Pressure. Pounds per Square Inch.	Counter Pressure, 1 Atmosphere.		
	Velocity of Outflow Steam. Feet per Second.	Kinetic Energy. Foot Pounds per Second.	H. P. of 500 Foot Pounds per Second.
		Per Pound of Steam per Hour.	
60	2421	25·29	0046
80	2595	29·06	0053
100	2717	31·86	0058
120	2822	34·37	0062
140	2913	36·62	0066
160	2992	38·63	0070
180	3058	40·35	0073
200	3115	41·87	0076
220	3165	43·26	0079
280	3294	46·83	0085

The steam having been completely expanded is blown through the buckets, and its kinetic energy is transferred to the wheel. After performing its work, the steam passes into the chamber O, fig. 1, and through the exhaust opening N. The angle of the nozzle to the plane of rotation of the wheel is 20°. In such a case, the peripheral speed of the wheel should be nearly half the velocity of the steam; but for practical reasons such a high velocity of the turbine wheel

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TWENTY HORSE-POWER STEAM TURBINE MOTOR.

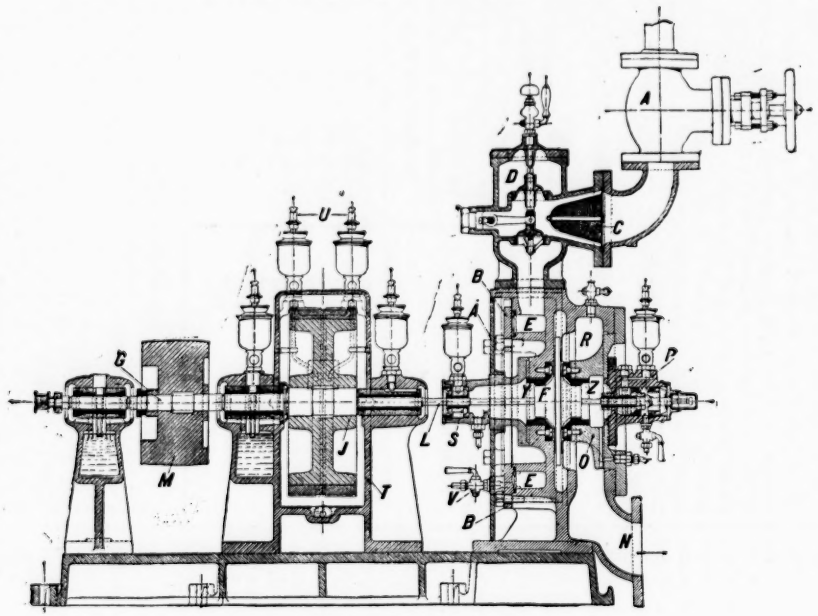


FIG. 1.—LONGITUDINAL SECTION.

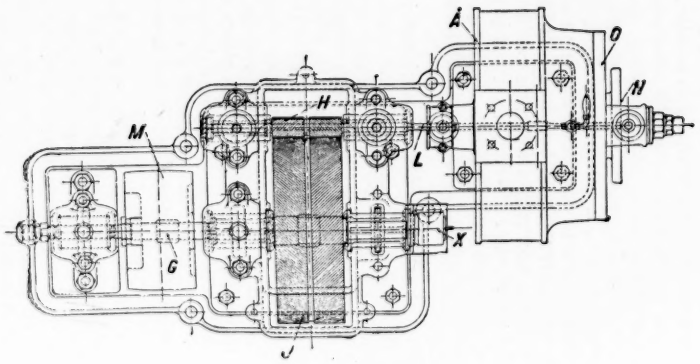
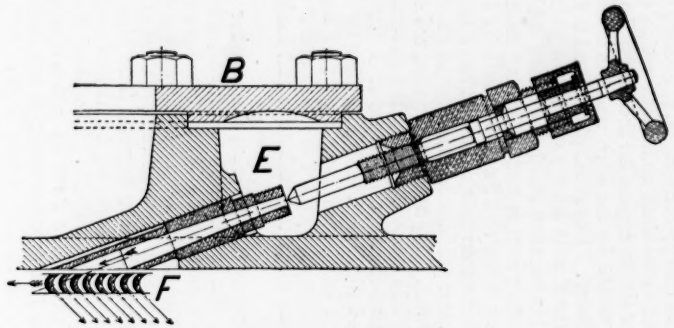


FIG. 1A.—PLAN.



SECTION OF NOZZLE.

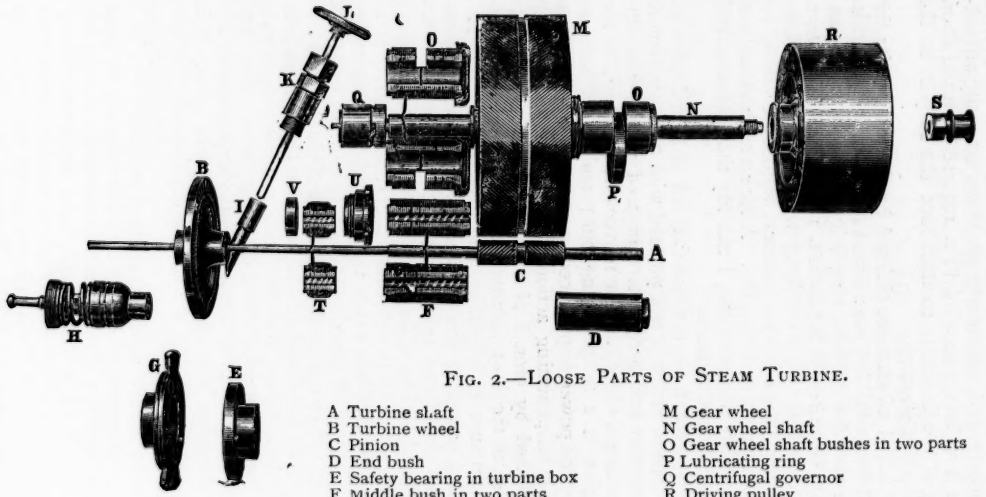
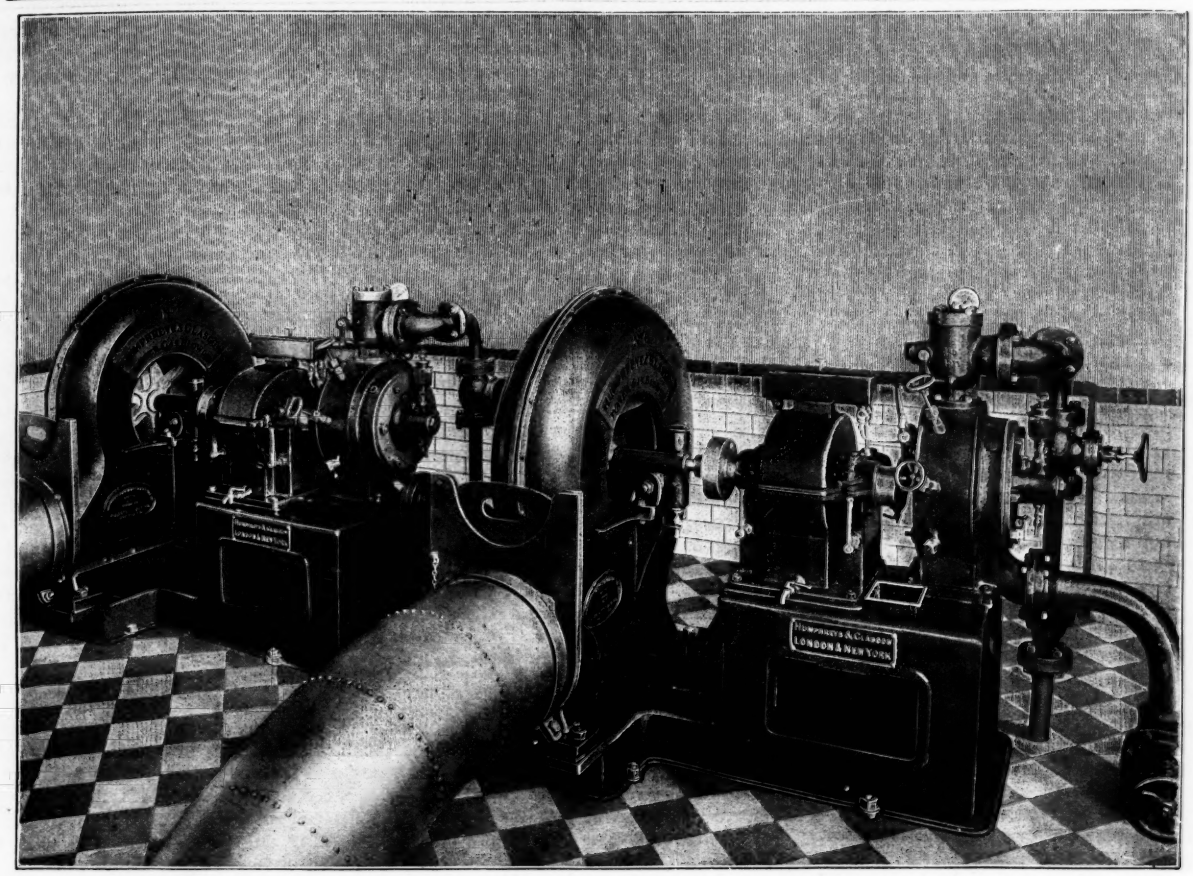
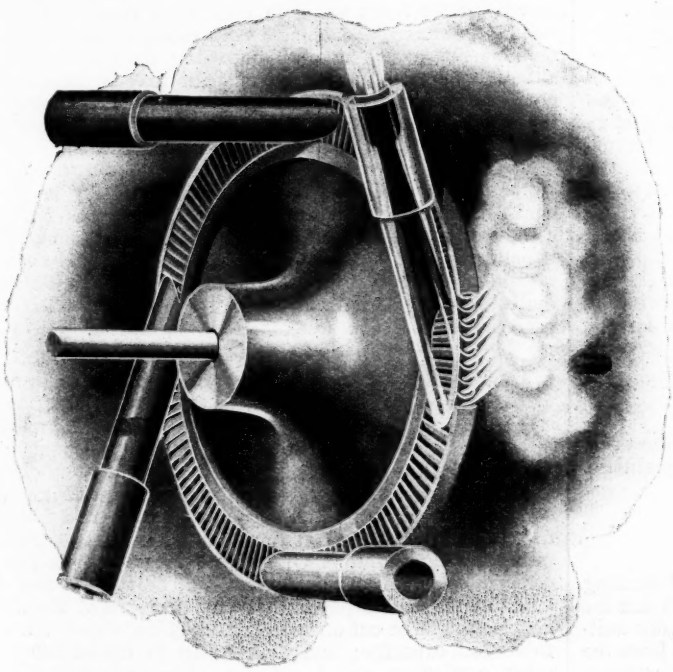


FIG. 2.—LOOSE PARTS OF STEAM TURBINE.

A Turbine shaft
B Turbine wheel
C Pinion
D End bush
E Safety bearing in turbine box
F Middle bush in two parts
G Safety bearing in box covers
H Ball bush with adjusting spring
I Steam nozzle
K Stuffing box with stop valve to nozzle
L Wheel to valve spindle
M Gear wheel
N Gear wheel shaft
O Gear wheel shaft bushes in two parts
P Lubricating ring
Q Centrifugal governor
R Driving pulley
S Stop nut with pulley for connecting to tachometer
T Tightening bush in two parts
U Adjusting nut with spring
V Friction gland



Two Fifteen Horse-Power Turbines and Blowers at the Romford Gas-Works.



Turbine Wheel and Nozzle.

is not used. With steam at 120 lbs. pressure per square inch, the velocity of the outflow steam would be 2822 feet per second, giving a theoretical peripheral speed exceeding 1200 feet per second. The actual speeds adopted are shown in the table.

Table of Speeds of Turbine Wheels.

Size of Turbine.	Middle Diameter of Wheel.	Revolutions per Minute.	Peripheral Speed. Feet per Second.
5-H.P.	100 mm. = 4 in.	30,000	515
15-H.P.	150 mm. = 6 in.	24,000	617
30-H.P.	225 mm. = 8¾ in.	20,000	774

With the larger turbines, the diameter of the wheel and its peripheral speed are increased, until, with the 300-horse power, the peripheral speed of the outer rim of the wheel is 1450 feet per second, or over 16 miles per minute; and this would give a steam consumption of 9·8 lbs. per theoretic horse power. It has been found difficult to produce a material for the wheels that, with an ample margin of safety, would withstand the strain produced by the centrifugal force at this high speed. The material now used is nickel steel.

To overcome the impossibility of producing a wheel accurately enough balanced to revolve about its centre of gravity at a speed of 1450 feet per second without causing a side pressure destructive to plain bearings and a rigid shaft, De Laval conceived the flexible shaft, which he has patented. This shaft, bold in idea and ingenious in its application, may be regarded as among the most striking and remarkable inventions in steam engineering; and in its adaptation to the steam-turbine it at once attracts the attention of the constructive engineer. The shaft upon which the turbine wheel is erected is made very slender, which gives it flexibility, and has its bearings far away from the wheel, so that the shaft can spring and permit the wheel to swing a little in its plane of rotation.

A firm shaft, with bearings near to the wheel, has been found impossible in practice, because the most careful turning cannot bring the centre of gravity of the wheel exactly in its geometrical centre; and the fault causes vibration, which immediately destroys the bearings. On the other hand, when the wheel is mounted on a flexible shaft, there will also be vibrations; and these must increase with the speed. At a certain speed, however, the phenomenon arises that the wheel takes a new centre of rotation very near its centre of gravity. The more the speed is afterward increased, the nearer will be the centre of rotation to the centre of gravity.

The speed at which the wheel rotates when the before-mentioned phenomenon occurs, is called the "critical" speed of the wheel; and, having passed this speed, the vibration disappears, and the shaft afterwards runs smoothly in its bearings. This critical speed occurs well below the normal speed of the turbine, and marks the disappearance of all vibration. The Romford machines (see last page), are usually driven at a speed of 25,000 revolutions per minute, running perfectly smooth and cool at the end of a long day's work. The shaft is supported in three bearings; D and E (fig. 2) being the pinion bearings, and H the main-shaft bearing, which carries the greater part of the weight of the wheel. There is an additional bearing, T. This is flexible, being entirely free to oscillate with the shaft before and after the critical speed is passed; and its only purpose is to prevent the escape of steam when running non-condensing.

I may here draw attention to this remarkable feature in the construction of the turbine—viz., that although high-pressure steam is admitted to the turbine case (we use 120 lbs. pressure), no stuffing-box or gland is requisite to retain the steam, and no leakage is at any time observable. All the bearings of the flexible shaft, as well as the gearing, are lubricated automatically from a central reservoir. No cylinder oil is used, and there is no oil in the exhaust steam—an important feature when the exhaust is attached to a feed-water heater or surface condenser.

To regulate the high speed of the turbine, a governor of the centrifugal type is employed—small in dimensions, but extremely sensitive in action. The weights or moving parts are semi-circular in form, with an arm at one end, placed at right angles with its axis, and reaching just beyond the centre of the shaft, which the weights encircle. At a point near the axis, the arms are fitted with hardened steel centre pins, which are also pivotted into the sliding spring seat D. When the speed exceeds the normal, the two semi-circular weights affected by the centrifugal force spread apart; but being held at one end by the pivot pins, the movement of the parts is not parallel, and the opening assumes a V-shaped form, and the end of the arms which are at right angles to the shafting are forced forward, and press against the spring seat. The regulating movement of the governor is transferred to the balanced governor valves by a link motion.

As the moving parts of the governor hang upon knife-edges, there is but little friction, and the action is very powerful. Indeed, its control of the turbine speed is so complete that when running the blowing plant in water-gas practice, the alteration from the effective use of the blast to no load at all is scarcely noticeable in the action of the turbine; and when the blast is suddenly put into full use, the water column of the gauge is only momentarily affected to the extent of about 5-10ths of an inch. As the gauge is taken at some distance from the blower, this loss of pressure is mainly due to the friction of the air in the blast pipe between the blower mouth and the point at which the gauge is fixed. The following figures show the close governing of the turbine speed by the apparatus employed for the purpose:—

Revolutions of Blower per Minute.

With Full Load.	Without Load.
2459	2471

And as the gearing between the turbine and blower is exactly 10 to 1, the turbine speeds under the conditions given were:

With Full Load.	Without Load.
24,590	24,710

A difference of only 0·48 per cent.

Some idea of the general efficiency and cost of running may be obtained from the following figures which are the average of a number of tests made at Romford under suitable conditions; the whole of the exhaust steam from the turbine having been collected and condensed for the purpose: With the turbine of 15 brake horse power, at 25,000 revolutions per minute, running with three nozzles open, and with a boiler pressure of 120 lbs. per square inch, the consumption of steam was 34·45 lbs. per 1000 cubic feet of gas made. The steam consumption of a high-speed reciprocating engine, working with belt gearing on to the blower, was, under similar conditions, 52·35 lbs. per 1000 cubic feet of gas made.

The small space occupied by these machines, as well as the readiness with which they may be erected, are points of importance. The Romford engines and blowers were delivered completely fitted, and were carried into the engine-room packed in a case. No special foundation or holding down bolts were required; the apparatus, being self-contained, was simply placed on the floor in a suitable position, and steam and exhaust pipes connected, when they were at once ready for running.

The whole conception and design of the De Laval turbine is so novel, and each feature of its construction so interesting that I have been led in my description to enter at greater length into some of the details than I originally intended. The points, however, of which I have made mention—viz., the turbine wheel, the diverging nozzle, the flexible shaft, and the construction of the bearings and governor, are so entirely different to anything previously in use, that some detailed description appeared necessary, in order that the possibility of running a motor with safety up to 30,000 revolutions per minute might be realized.

The turbines at Romford, when running, are in charge of an intelligent labourer, who has been trained to the gas making; but so simple is their design, that there is far less risk of accident than would be the case with ordinary high-speed reciprocating engines. A slight opening of the safety valve and drain cocks sufficient to warm the steam casing, and then with a slightly increased steam supply the wheel starts revolving, noiselessly and smoothly; and as the volume of steam is increased, so the speed gathers, and in less than five minutes the machines and the fan are running at their highest efficiency. So in stopping; a gradual closing of the steam valve reduces the speed until a very slight hand pressure on the smoothly running coupling brings the fan blades to a stop without any shock.

For all high-speed work, the turbines should prove invaluable; and with suitably arranged gearing, they would appear as well adapted for exhausters as for blowers. With high class workmanship, the exhauster might be considerably reduced in size; and by running at higher speeds than is now customary, greater perfection would be attained in the maintenance of any desired vacuum without oscillation.

Unlike the reciprocating engine and other turbines, the De Laval has no stuffing-boxes, no glands, no packing, no working parts under pressure, and consequently no leakage—in this respect differing from all other motors. The efficiency of a steam-engine as given in a shop testing room may be of the best; but with each day's running, leakage steadily increases, and efficiency decreases, while the turbine remains practically unaffected, owing to the fact that, although a very high pressure of steam may be used, it does not come in contact with the moving part—the buckets of the wheel being the most likely to suffer from the cutting action of the steam, and these are easily renewable.

During the months these turbines have been running at Romford, the attention required has practically been not worth mentioning. As already stated, there has been no escape of steam from glands, necessitating repacking; no knocking in bearings requiring readjustment; and even as regards appearance, the design is so simple that the ordinary duties securing cleanliness are all quickly and effectually performed.

Discussion.

Mr. F. W. Cross (Lea Bridge) said he had been favoured with a view of the turbine referred to in the paper at work, and he desired to thank Mr. Child for the very lucid manner in which he had described its operation. The apparatus was beautiful in its simplicity, and this was its great charm. He did not wish to overburden Mr. Child with visitors, but he would recommend anyone who felt interested to do so, to go and see it at work at Romford, for it was a dream of perfect workmanship. One was hardly in a position to criticize so novel an apparatus. But he noticed that Mr. Child stated in his paper that one or more of the steam nozzles might be cut out when the turbine was not loaded to its full capacity; and this, taken in connection with other particulars, raised a doubt in his mind which did not occur to him on seeing the machine. As to the controlling of the steam, Mr. Child stated in the paper that one or more nozzles might be cut out when the turbine was not loaded to its full capacity; but he did not say whether the turbine ran at a lower speed, and whether at that lower speed it would give a lower pressure of air. It seemed to run through the paper that there was one speed for the turbine and one pressure for the air. In dealing with water-gas apparatus, the pressure of the air should be under control, so as to increase or decrease it as desired. He did not gather from the paper whether or not control over the air pressure could be exercised perfectly. He would also like to ask what was the action of the steam on the buckets, and whether it was dried

or superheated in any way, except by an anti-primer in the boiler. What would be the action on the buckets of wet as compared with dry steam. The pressure of steam was stated at 120 lbs., and he should like to know whether this high pressure was used primarily for the working of the turbine, or was for the working of the gas apparatus. Of course, they required steam at high pressure for the generator; but if the pressure was adopted for the turbine alone, the table would seem to prove that, as the initial pressure ranged from 60 lbs. up to 220 lbs., there was a decrease in the proportion of benefit derived from every 20 lbs. of steam. Thus the increase in horse power at 500 foot-pounds per second between 60 lbs. and 80 lbs. pressure was 0·007; between 80 and 100 lbs., 0·005; between 100 and 120 lbs., 0·004, and so on. There was a gradually decreasing figure the higher one went in the pressure of steam. It occurred to him, therefore, that the 120 lbs. pressure might, with economy, be reduced to 100 lbs., if this were sufficient for the generator. Mr. Child gave the consumption of steam, per 1000 cubic feet of gas made, by the turbine and steam-engine respectively, and that was perfectly clear in regard to Mr. Child's operation with the blower. However, the working conditions at various places were very different; and it would be extremely useful if these figures could be supplemented by a comparative statement of the steam consumed per indicated horse power developed. This was the question generally considered when laying down new plant. The last point he would refer to was the connection of the turbine to the blower. He was not quite convinced that connecting it direct, as had been done at Romford, was altogether desirable, because it was so close. Accidents did sometimes happen; and if the blower suddenly blew up, it would be a great misfortune for everyone if the turbine went with it.

Alderman MILES (Bolton) said Mr. Child was to be congratulated on having favoured the Institute with a paper which would be keenly read, and would long remain of the greatest possible interest. It was a paper which it was impossible to criticize; one could only admire, as he did. One or two questions occurred to him, which might be worth referring to. In the first place, as this machine had only been at work for a few months, and no doubt under the best conditions, one naturally asked what would be the results in the future, especially when one noticed the statement, which to him seemed somewhat alarming, that a turbine of 15 brake horse power ran at 25,000 revolutions per minute. This was a tremendous speed; and personally he should feel some apprehension about it. He took it that the previous speaker desired to know what the economy of this particular machine was with regard to steam consumption. He understood it was about 30 per cent. as compared with the highest speed reciprocating steam-engine. If, as he took it, this referred to one of the best and most modern engines, it was an important step in the right direction. He should, however, like to know what the prospects were with regard to wear and tear. He feared this would be rather heavy, though possibly his fears were groundless.

Mr. J. P. LEATHER (Burnley) said he could not add much to what had been said by previous speakers, but naturally one wanted to have some definite figures, which, no doubt, Mr. Child would have given if he could have done so, as to the consumption of steam per horse power developed. As had been remarked, it was not much use giving the relative consumption per 1000 cubic feet of gas, unless they knew how much steam they were using per 1000 cubic feet in their present blowing machinery. On reading the paper, he wished the same thing had occurred to him when putting in his water-gas plant. Some nine years ago, he went to see Parson's steam turbine at work at Newcastle; and it struck him then as being extremely interesting to see steam converted into power by such simple means, without all the cranks and connecting-rods of a reciprocating engine. But the question of economy of steam was the main point to be considered; and this seemed at the time to be a little uncertain. The Hon. Charles Parsons told them that, according to tests made with alternating current dynamos by a Cambridge professor, it showed a very high efficiency. But such tests might easily be delusive; and they were still without definite figures as to the real consumption of steam per horse power. While the paper was being read, he had tried to form some estimate; and it looked to him as if it would work out to about 3 lbs. or 4 lbs. of coal and about 60 lbs. or 80 lbs. of steam per horse power. In a carburetted water-gas plant, the fan should, in his opinion, work continuously. Some people slowed down the engine when not blowing; but he thought that this was a mistake, because the small economy thus obtained was counterbalanced by the disadvantage of relieving the blast-pipes of pressure, which pressure was a great safeguard against the blowing up which had been referred to. If they had a higher pressure in the blast-pipe than they ever had in the superheater, they would never get any gas back into the pipe, and there would be no explosions. With regard to the wear and tear, he should like to ask whether there was any wear on the turbine wheel itself from the impact of the steam. If it were perfectly clean steam, it might not be so; but where they had anything carried forward with the steam, which might happen, more especially if they were using dirty water, for instance, it might be different. In his own case, he had some steam-valves, nearly closed, which were cut as if by a sand-blast; and the question was whether, having the steam at a very high velocity, the turbine wheel itself would not be cut in the same way. But if it were, it was not an absolute condemnation of the machine, because it did not seem to him that, even if the wheel had to be made of very high-quality metal, it would be expensive to renew it. This brought him to the question of how this worked out as regards cost. How did the first cost of a machine giving 15 brake horse power compare with the cost of a 15-horse power steam-engine? It seemed with the turbine there could not be the perfect efficiency of the steam, because Mr. Child told them they did not work at anything like the theoretical peripheral speed, but only at about half that which would be the actual kinetic velocity of the steam from its pressure. With steam which should have a velocity, at 120 lbs. pressure, of 2822 feet per second, instead of giving the theoretical peripheral speed of 1200 to 1400 feet per second, in actual work the speed adopted was 617 feet. This meant that there must be a considerable pressure in the exhaust steam, and that they did not get complete expansion so as to give the theoretical full value.

Mr. S. O. STEPHENSON (Tipton) said the steam turbine interested him very much, and especially its introduction into gas making in connection with carburetted water-gas plant. It seemed as if Mr. Child was working very successfully; but towards the close of his paper he suggested the adoption of this apparatus for exhausting. There was considerable difference in the velocity required for blowing up a carburetted water-gas producer and working an exhauster. In the latter case, it was comparatively very small; and he felt a little doubtful as to the satisfaction to be obtained from a steam turbine for the slow speeds required for this apparatus. He should like to know Mr. Child's opinion on this point. It was much more necessary to have perfect steadiness in the case of an exhauster than for blowing up a producer, in which case a certain amount of fluctuation did not matter.

Alderman MILES asked if this was the first introduction of the De Laval turbine in this country. If not, perhaps Mr. Child could tell them where it could be seen driving any other form of machinery.

Mr. W. W. HUTCHINSON (Barnsley) asked if the author would put on record the actual cost of the turbine as compared with that of the usual steam-engine of similar size, and, if he had them, the other attendant expenses of doing the same amount of work. He should also like to know whether a pressure of 120 lbs. was necessary in order to make a success of the turbine system. With regard to the ordinary exhausting of gas, he assumed that if such a pressure was necessary to render the turbine successful, it would involve, in many cases, the taking out of the ordinary boilers, which were generally adapted to 50 lbs. or 60 lbs. pressure; and this would have to be taken into account in comparing the two systems.

Mr. CHILD, in reply, said the number of questions which had been asked put him in somewhat of a difficulty. He was not the inventor or designer of the machine referred to in his paper, but simply a user, and his use of it had been confined to the last few months. But it had been apparently so successful that he had acceded to the request of Mr. Davis, who had seen the machine, to bring the subject before the meeting. They must therefore treat the paper with every indulgence, as it was simply brought forward to afford information. He would give all he could, and, if possible, obtain the further particulars asked for, if he was not able to give them at the moment. With regard to the cutting-off of the nozzles, the speed of the machine was readily adapted to the requirements of the work. The operator determined the amount of pressure to which he

wished the blast to be raised—say, 20 inches—and then set the machine to obtain it. As it was fitted with four or six nozzles, it was better, if he found he had too much pressure of air, to cut one completely out than to partly close the whole of them. But he could adjust the governor just the same, so that it was fairly in action without being unduly wide open or closed. Having determined, by a little experiment—say, after half-a-day's working—that four or even three nozzles were sufficient (in his own case they had dropped to three, although the machine was fitted with four), the steam was used at the regular boiler pressure, rather than being throttled by the use of any governor. Mr. Cross had also referred to the question of superheated or wet steam. Wet steam undoubtedly would be prejudicial to the turbine wheel, and would have a bad effect on the buckets; but they did not attempt to superheat the steam. Still, the drier and hotter the steam was for turbine use the better. There would be no part which would be effected by introducing superheated steam; and those who cared to do so would obtain an increased advantage. The pressure of steam under which they worked at Romford was that most suitable for the gas generator; and practically they used a little over 100 lbs. He put down 120 lbs. because this was the pressure at which the safety-valves were set to blow-off. But it rarely worked up to more than about 105 lbs.; and 100 lbs. for the making of carburetted water gas was about the most suitable pressure. High-pressure steam would be equally effective, or a lower pressure, even down to 60 lbs. In fact, as Mr. Cross had pointed out, the figures in the tables showed that lower pressures—60 lbs. or 80 lbs.—compared favourably with the higher ones. He was unable to give the steam consumption per indicated horse power. He had made what experiments he could in the time he was able to devote to such things; but he need not tell gas managers that at a small works like his own, where he had not assistants in every department, but had to overlook the whole himself, he had not a vast amount of time to devote to experimental work. He did, however, go so far as to make an experiment between the use of the turbine and a reciprocating engine which was brought to the works actually to compete against it, being designed for this special purpose. It would not be right, as it showed such an unfavourable result, to state the name of the makers; but it was an engine constructed purposely for blowing, and was brought to his works and set up in the same engine-room and worked on alternate days—one day with the turbine, the next with the engine. The results obtained were shown in the comparative figures he had given as to the quantity of steam used per 1000 cubic feet of gas made. The makers of the turbine were themselves conducting some exhaustive experiments as to the consumption of steam per indicated horse power; and as soon as they were completed, he had no doubt they would only be too glad to publish them, not only to gas engineers, but to others who were likely to use turbines. In reply to Mr. Miles, he might say that these turbines were largely in use for the purpose of driving dynamos, as he was informed by the makers; but this was the first application of them in a gas-works for the driving of fans for carburetted water-gas making. With regard to the question of wear and tear, he thought the best he could do was to read a paragraph written by Mr. C. Anderson, who was largely engaged in the design of this turbine. It stated, with regard to the durability of the machine, that the author would only mention that at a large cotton-mill they had a 100-horse power turbine motor which had been working for two years day and night. When he went to instal a 300-horse power turbine motor at another part of the mill, he took out the bearings and gearing in order to ascertain whether the parts were worn. But scarcely any signs of wear could be detected; and the machine was put together again without repair for renewed work. If anyone saw the turbine in actual action, they could readily understand that there was not much wear and tear going on. The wheel itself did not come into contact with any part of the case, but ran completely free, both at the sides and at the periphery. The only part which touched was the steam-nozzle, which was lying at an angle of 20° by the side of the buckets; and he should imagine that even there the pressure of the steam would be sufficient to keep the wheel running free from any contact with the side of the nozzle itself. In the bearings, the motion was entirely rotary; and with such motion there was very little wear as compared with any sliding or reciprocating engine, like a slide-rod rubbing in a stuffing-box. One quickly got all the packing worn out of an ordinary reciprocating engine, because of the constant alternating motion, which rubbed the packing first in one direction and then in another. But even in a rotary vane like the stuffing-box of an exhauster, one scarcely even had to repack the rotary valve, which remained practically tight. Then regarding the question of cost, he was unable to go into that, because he did not invite any tenders for the apparatus. The contracts were already made for certain work—as he had before explained, for reciprocating engines with shafting, belting, and detached blowers. But he was afraid of the shaking of the buildings and the floors; and it was to meet this special difficulty, as to the possible destruction of the floors and the walls of the building by vibration, that the arrangement was made between the contractors and himself to substitute the turbine for the other engine. It was to be simply an exchange; so there was no alteration in price. He had tried to obtain some figures himself, but was unable to do so with any satisfaction; and the makers hardly cared to go into the question for him to put before such a meeting as the present. Anyone who thought of using such things would, of course, have to obtain comparative estimates from engineers. Mr. Stephenson had raised a question as to the use of the machine for exhausters. This was only a suggestion on his (Mr. Child's) part; but he was of the opinion that it might perhaps be reasonably and profitably done. The high-speed turbine was cut down by gearing very simple in its action, which he should be happy to show to anyone in the adjoining room, and with another series of gearing the speed could be reduced to that which would be really suitable for gas exhauster purposes. He was rather inclined to think, however, that exhausters were not run at sufficiently high speeds, probably because they had not had engines and appliances which would give these speeds effectively. He recollected on one occasion, when he went to a first-class firm in London in order to make arrangements about some new engines for exhausters, that they showed him some engines coupled direct to blowers which they proposed to run at such a high rate of speed that, as the shop foreman told him, the connecting-rod simply looked like a line of light. Now, lines of light in a reciprocating apparatus did not commend themselves to his judgment at all. When they got a rotary line of light—such as could be seen with a turbine wheel running 30,000 revolutions a minute—he was not at all disturbed; but he did not like the idea of so suddenly checking anything that was running at so high a rate that it could be so described. The makers of these engines, however, evidently had the idea that this high speed was necessary; and he quite agreed that they could work with no oscillation of the gauge at all if they ran with such high speeds. If makers of exhausters, instead of increasing the size of the apparatus, would devote themselves to putting first-class work into it, and running it at higher speeds, it would be better. In conclusion, he could only say he would endeavour to supplement the paper by obtaining information as soon as possible as to the quantity of steam used per indicated horse power.

MAINTENANCE OF INCANDESCENT GAS-BURNERS BY GAS COMPANIES.

By Norton H. Humphrys, of Salisbury.

The nature and extent of the work expressed by the term "maintenance" is so generally understood that there is no occasion to enter upon a detailed explanation; and it is equally superfluous to enlarge at length upon the desirability of such work being taken in hand by gas companies. The arguments in favour of doing so have been fully set forth in one form or another; and I am not aware there is anything to be urged against it. As there is now some prospect of the removal of the serious impediments that have hitherto operated to prevent a development of incandescent gas lighting in anything like a proportion adequate to the value of the invention, an appropriate opportunity is afforded for a discussion of the subject; and I have thought that this might be introduced by a plain account of some experiences in connection with the establishment of the system at Salisbury. Its installation in the city dated from the commencement of the new public lighting contract in the autumn of 1898; and we have now 600 public lamps fitted with No. 2 or No. 4 Kern burners; 200 outside shop lights, mostly fitted with two "C" burners in each; as well as some 200

customers representing 2000 interior burners of various kinds, including No. 0 to No. 4 Kern, "C," "York," and "Gem" Welsbachs. The whole forms a standing advertisement of the fact that gas as a lighting agent is not yet played out, but stands foremost in cheapness and efficiency, that could not be secured by any other means.

The work of maintenance is essentially one of those things that, if worth doing at all, is worth doing well; and any attempt to run it as a stop-gap in connection with existing duties, and without increasing the present staff, is not likely to prove satisfactory to either party concerned. It is worse than useless to take up the thing in a muddling, half-hearted sort of way, as something to fill up the spare hours of the men who read the meters or attend to the lamps; and if the Directors expect to have it brought in without increasing the present staff, it is better to let it alone. If the scale of operations permits, it should be distinct in itself, and in charge of men who devote their whole time to the work. But the maintenance staff can, in any case, be utilized for canvassing and disseminating information as to the various uses of gas. It is a good plan to provide them with printed leaflets, setting forth the terms on which gas is supplied, the facilities offered in the way of hire, hire-purchase, &c., as this avoids any misunderstanding. If people are told that they can have a stove for 10s. a year, they are apt to forget, and when the bill comes in after a few months, to think that the price named was 7s. 6d.; but I never met anyone who forgot in the other direction. A copy of the printed slip is the best answer to such lapses of memory.

The subject naturally divides itself into public lighting, outside lighting, and inside or interior lighting; and I am not in favour of partial maintenance, though I understand it has been successfully applied elsewhere. It seemed to me that to ensure the real end in view—viz., the display of efficient lighting—nothing short of entire and complete control would be successful. So these remarks are addressed exclusively to inclusive maintenance. After some experience, which goes to show that the customers cordially welcome any reasonable arrangement that will improve their lighting efficiency, and, as a rule, take as much interest in the care and maintenance of the mantles as we do, I can quite see that there is no reason why partial maintenance should not prove a success; but, in practice, there is no advantage afforded by it over inclusive maintenance sufficient to warrant the complication of affairs by introducing it. At the same time, I am prepared to take on partial maintenance or anything else that will tend to retain and to consolidate business.

The bulk of our public lighting is taken by the Town Council; but, in addition, we have five authorities outside the borough boundary, and previous to 1898 it was all carried out by means of flat-flame burners on the average-meter system. The whole of the outlying districts and also about half of the town lamps were left out during four summer months. In June, 1898, there was a great demand for improved lighting; and we put in a tender for No. 2 and No. 4 Kern burners and all-the-year-round lighting, which was accepted. This proved such an advance, both as regards efficiency and economy, on the old system, that the outlying authorities soon fell into line; and we have now no flat-flame burners or winter lighting—the whole being incandescent and all-the-year-round. In some of the outlying districts we also had a moonlight clause, allowing for the omission of lamps on nights which may possibly be moonlight, but often are not. This also was done away with.

Having absolutely no experience or precedent to serve as a guide, the arrangements made in 1898 were such as would possibly be modified in the light of later knowledge. We had very little practical experience in maintenance, and our lamplighters had no knowledge whatever. So, as a commencement, the maintenance of the public lamps was committed to the outdoor foreman—the lamplighters having nothing to do with it beyond reporting defects. Our town office is centrally situated; and it had been the rule for each man to report himself at the conclusion of his round—the time of his doing so being booked. A complaint-sheet, with a column for each man, was arranged; and it is the duty of the foreman lamplighter to look up the defects as reported. This sheet was handed to the outdoor foreman, who was in attendance in readiness. The plan answers well, and is still in use. The maintenance men are present at the hour when the lamplighters are due, and proceed at once to remedy the defects, commencing with the most important thoroughfares. The defects are classified as follows: P, pilot out; M, broken mantle; C, choked with dust; N, naphthalene (with which fortunately we rarely have trouble). The foreman had a young man with him as improver, who in a short time was qualified to take charge of the maintenance; and it is in this way that we have trained five young men to a knowledge of the Welsbach burner. After dark, and in busy thoroughfares, we send a second man to carry the ladder; and an opportunity is thus afforded of getting an insight into the practical working of the burner. While introducing the system, we made several discoveries, one of the most important of which was the fact that of the different patterns of so-called wind-proof lanterns none could be relied upon as capable of admitting the use of a naked mantle, and that a glass cylinder or bulb must be used as a protector. The Welsbach Company did not at the time supply them; and I had to get some specially made.

By the end of 1898, we had 500 lanterns fully established; and our customers soon began to notice the lights, and compare them with their own. The first evidence of this was a widespread notion that we were using a special quality of burner and mantle; and there was a demand across the counter for burners and mantles similar to those used in the street-lamps. We commenced the supply of outside shop lamps on three-years hire-purchase terms, with an additional charge for maintenance, and next proceeded to take over isolated cases of indoor lighting, such as places of worship and public rooms. After about a year's experience on these lines, we felt ourselves safe to undertake any kind of work; and our efforts have been accepted with cordiality by our customers, and have given general satisfaction. We have not "rushed" the business, or used means of advertising other than an announcement printed on each bill, and a card stating terms. Many orders for maintenance are given to the men in the course of their duties, or are sent to the office as the result of seeing the men at work.

We do not undertake maintenance work for a less period than one year; and it is understood that our terms cover the whole of the burners on the premises. If it is suggested that one or two burners are not often used, and not worth including, we reply that it is not fair to give us the most risky and troublesome part only. This question has only arisen once or twice; and there has been very little difficulty of any kind. Our undertaking includes keeping the glasses clean and burners in good order, and the renewal of mantles, rods, and plain glass cylinders when necessary, but no fancy glass or other parts of burners. If required to take over burners at present in operation, they must first be put in proper order at the customer's expense. A large part of the business is for new burners, and comes from customers who would not be likely to have the system at all if they were not relieved from the trouble of attending to it.

We have now four men on maintenance work, one of whom takes the public lighting. Goods required are served to them out of stores, and charged to the particular lamp or consumer for whom they are used. A separate account is kept for each lamp or customer, so that in the event of an unusually large consumption of material the cause can be traced. The half-yearly totals of this book enable the cost of the whole to be arrived at, and are checked with the stock books. At first, the charge to each customer was entered in the stove-rent column in the rental-book; but later on a subsidiary book became necessary, showing stove-rents, hire-purchase, and maintenance in separate columns, the total of which is transferred to the rental-book. In all cases, the charge to each customer is rendered quarterly with the gas account.

As to financial results, I am not at liberty to publish figures, but may say that, although the maintenance department is not a source of direct profit, it is not an important expense or source of loss; while the indirect advantages are such as to leave no question as to the advisability of adopting the system. Notwithstanding the reduction of consumption due to the adoption of the Welsbach light, energetic canvassing of electricity in our district, and no growth or increase of population, our sales of gas have been well maintained at an increase of 5 or 6 per cent. annually.

THE FITTINGS BUSINESS AS AN AID IN THE SALE OF GAS.

By Robert Watson, of Hertford.

It is not often that the Gas Institute has included in its proceedings the discussion of any matters concerning more

immediately the sale of gas. Subjects of a purely technical character probably offer to members greater inducement for treatment and better opportunity for originality. It is difficult in everyday work, however, to run away from the fact that gas is, after all, made to be sold, and that for those in charge the question of demand is equal in importance to that of supply. Competition compels, and may increasingly compel, attention to the phases of the industry which relate to the consumption of gas; for though record outputs have still to be reported, these records will be more and more the result of both enterprise and hard work in distribution departments.

The means adopted by gas companies for the maintenance of progress in the sale of gas are various; and it would not be without profit if more frequent opportunities were taken to get expressions of opinions or comparison of notes from members as to the merits and demerits of the several methods employed. The paper now submitted may serve for the occasion, although its chief purpose is to suggest the more systematic development of the district fittings business, as a useful aid in increasing the output of gas. Differences of opinion may possibly occur as to how far advisable it is for a company to establish such a business, since enterprise of this character interferes in part with the trade of ironmongers. While there is something to be said in their favour, there is unquestionably a great deal more to be expressed on behalf of the gas industry.

It must be borne in mind that the *rôle* of fitters has already been assumed by gas companies, in providing and fixing cookers, &c., slot meter installations, and more recently, in the maintenance of incandescent gas-burners; and the result has justified the course adopted. The great demand for gas thus caused would never have taken place had gas companies depended upon traders, other than themselves, to let out on hire, or hire-purchase, what the public generally did not care, or could not afford, to buy outright. The success, indeed, of the enterprise strongly suggests that gas companies might well do more both in the supply of appliances needed by their customers, and in the popularization of gas in fields as yet untouched by them as gas-fitters.

It is a question, moreover, whether present-day circumstances do not force the situation, and preclude the consideration of the old argument, if advanced, of unfair rivalry with the ironmongery and fitting trade. Gas is not the only lighting and heating agent, and the trade does not, nor can it be expected to, confine its attention to the exclusive sale of fittings suitable for its use. In the presence of electric lighting competition, the interests of the gas company are better served by its own fitting staff than by those to whom it is immaterial whether a gas-burner or an electric glow lamp is sold and fixed. There may be no great need to fear that electric light will "spell ruin" for the gas company. Assurance as to the future is not nevertheless a reason for sitting still and watching excursions from the other camp, in the hope that countermoves on behalf of the gas industry will be made by the fitting trade. If anything is to be done, it must be done by the gas company. It is not perhaps an unmixed evil that gas suppliers must bestir themselves. Competition is ever the life of business and the incentive to progress, and the result may be to quicken both the search custom and the efforts to still further cheapen gas.

As gas-fitters, the company unfortunately may, in many instances, displace the middleman; but this individual is not a great help in retaining, still less in maintaining, the progress of the company's business. An illustrative case occurs to mind. The wardens of a certain church recently talked of electric lighting, because, thanks to the ineffectual efforts of a local gas-fitter, an experiment in incandescent gas-lighting proved a failure. With some reluctance, the authorities permitted the gas company to take the matter in hand, when it was found that the fitter had contented himself with trying incandescent burners on internal piping which was partially blocked with rust. Things were soon remedied, and in the company's favour. This is but one of various cases where the elimination of the middleman has helped to retain a gas consumer.

It does seem that any enterprise which brings about direct connection between gas supplier and consumer should be encouraged for all it is worth. The value of that connection is patent to anyone who has worked a company's fitting business. Proof of it is to be found in the cooker and fire trade, which, after all, is but a phase of such business. It is certain that the universal satisfaction given by cooking-stoves is due to the fact that they are supplied by those whose profit does not cease with the completion of the fixing. The continuous custom of the user of a cooker depends not merely upon the efficiency of the apparatus but of the gas supplied, and the company, in the dual capacity of gas fitters and suppliers, are in a position to guarantee this. A better example is furnished by slot-meter installations. The company who have undertaken this work may be sure of one thing—that most complaints made by slot meter customers can be attended to at the works themselves, since very few are on the score of inadequate piping, faulty burners, or inefficient stoves. The author considers that his own slot customers, (numbering nearly one-third of the whole) are far better lighted and served than the average ordinary gas consumer in the town. This obviously results from the close touch existing between the gas suppliers and the customers, and the company's control of everything from the main to the burner. It can safely be said that slot consumers from the flat-flame burners supplied with the fittings get 50 per cent. greater light efficiency than do those consumers who pick up their burners anywhere. The burners used with Hertford slot fittings are Bray's No. 5 and No. 7 economizer caps; and photometrical tests show that these develop a candle power which is nearly equal to that of the standard argand burner itself.

If further proof were desired of the advantage and value of gas companies' work as fitters, it would be only necessary to refer to the growing success of systems for the maintenance of incandescent gas-burners. The incursion of the company into purely gas-fitting realms is in this respect certainly justified; and there is ample evidence that further steps in like directions would not be unwelcome. The establishment of a good district fittings business on the part of the company is, indeed, a necessity, if efficiency and general satisfaction in the use of gas are to be ensured, and further progress in its popularization made. Putting aside the mere question of fitting employment, the company are in a far better position to help the average gas consumer. The staff, backed with the means of doing any resultant work, can the more readily offer advice to those customers in need of it, and even to those who do not particularly want it. From another point of view, the provision of a fitting depôt affords the consumer a better opportunity for verbally lodging his complaint; and this is not at all a bad thing, if the company desire to give all-round satisfaction.

The fittings business is especially valued by the author for its possibilities in propaganda enterprise. While supplying the facilities for executing orders, it also furnishes a convenient spot, being in the heart of the district, from which to carry on the work of popularizing and extending the use of gas among the unconverted. Canvassing and circularizing are more easily done and controlled from the town premises, and the staff have better chances of knowing when and where to put in the seasonable word. Advertising at not too infrequent intervals undoubtedly pays for itself. In the author's district, the changes are rung on the various branches of the Gas Company's fitting business, all of them being advertised in turn—sometimes by newspapers, sometimes by handbill, and always on the back of the quarterly demand-note. The great thing is to keep the gas company and their various enterprises constantly before the public. The company should, indeed, be in evidence, as far as possible, at all times.

Some of the progress made by the Hertford Gaslight Company during the past five or six years is undoubtedly due to the adoption of the methods indicated. The increase in the sale of gas—about 50 per cent.—is neither startling nor remarkable as compared with that in some districts; but it is encouraging, in view of the relatively small gain (3 per cent.) in the population of the town during the last decade. A satisfactory feature about the Company's undertaking, however, is the fact that some two-thirds of the names of the consumers are to be found on the books of the fittings business. While the cooker trade belongs rather to the usual branches of the distribution department, it may be of interest to state that during the period mentioned the ratio of cooking-stoves to consumers has improved from 1 in 18 to 1 in 3.

The establishment of a fittings business may, in the case of a small company, be a matter for consideration on the score of cost; but little difficulty as regards this need be apprehended. The venture, coupled with the development of the company's distribution branches, should not involve an addition to the expenditure side of the balance-sheet.

At the same time, it must be confessed that no great profit can be expected in small or moderately populated districts; and this may be the case although house-fitting charges are not of an undercutting character. The fittings business, as developed for the purposes of a gas company, cannot well be used as a dividend-earning concern if it is to achieve all that is desired from it. Nevertheless, if it does not earn dividend, it aids in extending the use of gas, which is much the same thing. For the latter reason it is worth the extra amount of trouble and work it admittedly involves.

The actual profit on the business in Hertford—treating it apart from the usual distribution branches, and debiting it with a fair proportion of the charges for rent, rates, and taxes, insurance, salaries, light, interest on working capital, &c.—barely pays for supervision. It, however, helps in the maintenance of the town office, which would still be necessary for rental and collecting purposes. All the ancillary branches of the Company's undertaking—such as burner maintenance, the cooker trade, slot fitting, meter fixing, and service laying—are operated through the fittings business. They are, of course, differentiated in the process of book-keeping. The centralization of the work tends to facilitate administration, and to minimize the relative cost of the several departments.

As far as the district is concerned, the varied character of the work and place of employment keeps the staff fairly well in touch with consumers, and it is frequently the means of procuring chances for custom and improvement which would never otherwise be heard of. In the first case, canvassing from the fitting centre is sometimes successful. If improvements are possible, suggestions are made, and, occasionally, should no other course be effective, sample fittings, burners, and the like, are put in on approval.

It is always well to embody recommendations in writing. In one recent instance, where the work of improving the general lighting of a certain building was, after many complaints and as many suggestions, at length undertaken, the proprietor kindly remarked that the electric lighting competition had stirred up the Company. It was with a feeling of satisfaction that reference could be made to letters written two or three years previously, pointing out the trouble and the remedy. Where competition exists, the information obtained through the fittings staff is sometimes useful for checkmating purposes. Electric lighting companies are fairly keen on the main chance, and now and again take extreme steps to displace gas, with the knowledge that some people who adopt their lighting will put up with the increased cost rather than confess to having made a mistake. It is better to endeavour to retain custom than to expect its return as a matter of course.

A good fitting business already established in the district is likely to be of further considerable use to the gas company. The present welcome move in the direction of a lower-grade gas makes the direct interest of a company in fittings keener and more important. The education of the consumer as to the advantages—not to say the need—of the change is necessary; and this will be undertaken by none if not by the gas company. Occupying the position not only of gas suppliers but of fitters, the company are manifestly in a better position both to undertake this when the time comes and to do preparative work in the meantime. It is too much to hope that with the change to a more economic gas the present flat-flame burners will all be discarded; and those consumers who still retain them are not likely to be satisfied with the alteration. It is well, therefore, to give them, at the district premises, the opportunity for venting their dissatisfaction. The company are at least enabled, in return, to furnish them with some practical advice, backed up with the resources of the whole fittings business.

A gas company cannot do too much both for the present and the future satisfaction of their customers in recommending the adoption of incandescent gas in preference to flat-flame lighting. Still greater success than is at present achieved may be anticipated in this direction, and with it a stronger hold on house and shop lighting. The promised cheap—and it is to be hoped not less well-made—mantles will afford a welcome stimulus to fitting enterprise in incandescent lighting. Those who have, through their fittings business, come into contact with consumers, know to what extent the cost of the renewal of mantles has retarded progress in gas matters, and tended to take the edge off arguments in favour of the system. When one sees across the water—for instance, at Brussels—the effect of low prices in the almost absolute predominance of incandescent gas-burners, and the comparatively small show of electric glow-lamps, one regrets the chances and possibilities which have been lost at home. The sale in Hertford of both burners and mantles at something like Continental prices would a year back have been of greater service in competing with electric light. The satisfaction shown by the general public with incandescent gas lighting since the recent conversion of Hertford public lamps to this system, and by consumers who have accepted the Company's offers of maintenance, affords, however, some hope of further business, when once the cheap mantle is on the market.

Although the active recommendation of incandescent gas lighting does not conduce to an increased output of gas, the fittings business is wisely used if the pocket of the consumer is on every occasion studied. An economical customer is a very good friend to the gas company, not to say an excellent and cheap advertising agent.

There is one branch of fitting enterprise which, in the author's opinion, might be still further pushed. It was referred to both by Mr. Norton H. Humphrys and Mr. A. Dougall in Institute papers some years back, but has not been undertaken by many companies. It is that of the wider application of the principle involved in slot-meter and hire-purchase methods. The adoption of the slot-meter system is primarily based upon the fact that the small householder is unable to find the means of fitting up his premises. The supply of cooking-stoves on hire or hire-purchase is due to much the same cause—the inability or non-desire of the customer to buy the apparatus himself. The removal, however, of this hindrance of immediate expense has opened the way for an extended use of gas.

There can be little reason why the company's fittings business should not be employed to meet both present and prospective customers in other directions, where cost is the consideration. There are many cases where people prefer and are sound enough, for quarterly accounts, but who yet find a bill for (say) fitting up a house too much for their current income; or, again, where tradesmen desire to make considerable alterations in their shop lighting, but are deterred by the expense. In some such instances, the so-called "free wiring" system of the electric lighting companies has its attractions, and little thought is given to the after heavy cost of the lighting bill. It is good business done if the gas company can meet these and similar cases by doing the desired work, and spreading the cost to the customer over a number of quarters on the hire-purchase system. The offer to do so frequently robs the contemplated scheme of the fear of expense, and may add to the rental. The enterprise does not relatively require more capital than slot-meter installations; the capital is, after all, but temporary; and the average return in gas consumption will certainly be greater. The principle is being adopted at Hertford; and it is expected that by thus giving the customer, where advisable, the option of getting his work done on terms accommodated, within limits, to his circumstances, the Company will gain in the sale of gas.

The idea of meeting the varied requirements of the consumer generally has led to the adoption of two schemes in another branch of the fittings business—that of incandescent burner maintenance. Since another paper dealing with this subject is before the Institute, its discussion is not within the province of the author. It may, however, be mentioned that the schemes provide, at the option of the consumer, either for inclusive maintenance at 9d., or for partial maintenance at 4d. per burner per quarter—the material in the latter case being paid for separately. In both schemes a reduction is made for a number of burners.

Speaking generally of a district fittings business, it is obviously out of the question to reckon up its advantages in millions of cubic feet of gas sold; but it is impossible to work the business without being conscious that it has a definite value to the gas company concerned. The greater facility with which the usual distribution branches can, through its agency, be administrated, and the additional means it affords of establishing a closer connection between supplier and consumer, are in themselves sufficient inducements to recommend the undertaking for any company.

Discussion.

Mr. S. Y. Shoubridge (Lower Sydenham), as one who had adopted the partial maintenance system, said he did not find in it any of the complications referred to by Mr. Humphrys. It was very simple, and saved a gas company from the risk of loss which might occur on the total

maintenance system. Mr. Humphrys had not given any figures as to the cost; and it was exceedingly difficult to ascertain what this was. He happened to know that the Welsbach Company, who had recently abandoned the maintenance system altogether, had found it to be a source of considerable loss. He was heartily in sympathy with nearly everything advanced by Mr. Watson, and thought the time had arrived when they should go out and seek for business a great deal more than they had hitherto done, especially in face of the increasing competition of electricity. In his own district, he had been making a special effort to get churchwardens and incumbents of various churches to adopt incandescent lighting, as he found that the electric light people had already captured one or two. He found his advances were very readily received by the people in authority; and he had already succeeded in displacing the old method by the incandescent system, whereby they improved the lighting enormously, and reduced the cost in one or two cases by more than half. This was a direction in which they should all strive to get a foothold before their competitors did so; and he felt sure that, if they followed the advice now given, they would be well rewarded for any efforts they might make.

Mr. J. West (Manchester) said there was no doubt they were somewhat handicapped, in being isolated individuals in their respective towns, while the electricians were numerous, all in their various circles advocating their special light. The suggestion that they should seek for business was one which struck him very forcibly when in the United States; and he thought they might learn a good deal from their American cousins in this respect. When at Milwaukee, he had an opportunity of looking into the inner working of the large Gas Company there, and found at the head of it a President, an Engineer, and a Secretary. These gentlemen were not much hampered by directors or town councillors. They were responsible for the whole concern; and they took it on and worked it in an admirable manner. One thing which struck him very forcibly was the way in which they got the plumbers and gas-fitters to help them. In order to enlist their co-operation, the Company would select a gas-stove, or gas-stoves, which they would order by the thousand, and supply them to all the tradesmen in the town to exhibit and sell, at a certain percentage of profit—the Gas Company fitting the stoves for the customers at cost price, or free of charge. In this way, the whole of the gas-fitters were interested; and the Company, buying in such large quantities, got the stoves at a cheap rate, and had absolute control over the whole thing. It was kept as a separate and distinct department. Literature was liberally distributed, and the whole town was canvassed. At Toledo, he found there was severe competition in connection with coal gas and producer gas. The Company supplying the former maintained very strongly that, for the same volume, the consumer got more heat with it—that it went further, and did more work. At the head of these departments, there were very superior men, with a staff under them quite separate from the general gas staff. If in this way they could get the co operation of plumbers and gas-fitters in England, it would be a great advantage, because in some cases it had been rather a bitter pill that gas companies should sell fittings. He contended, however, that companies and corporations should take up this department, if only to show how the work could best be carried out.

Mr. W. Whatmough (Heywood) regretted Mr. Humphrys was not able to publish the figures showing whether or not the maintenance business paid. In one part of his paper, he said he was willing to take up any system of maintenance, either whole or partial; and he (Mr. Whatmough) should like to know what proportion of consumers he had on each, and which paid him best. Mr. Humphrys stated that the public lighting was now established for the whole twelve months instead of eight as formerly, and that great economy had been effected. If this charge carried a reduction in the consumption, how was the increase of 5 or 6 per cent. obtained? Was it by an increased sale of gas for stoves or for motive power, or was it an increase in ordinary lighting?

Mr. W. Titley (Guildford) said he had been extremely pleased to hear these papers; as he had been striving for some time to get his Company to undertake the fittings business. He should like to ask Mr. Humphrys what anti-vibrator he found most useful on public lamps; whether the "C" or the Kern burner proved the more reliable; and also what price was paid for the mantles. He cordially agreed with Mr. Watson's remarks. At Guildford they had to face the electric light competition, but as yet had been able to keep its advocates at bay, chiefly by the adoption of incandescent lights in all the public lamps, keeping on good terms with the borough authorities, and introducing incandescent lights in the churches and chapels. He had just taken an order for 89 in one chapel. They had also introduced the maintenance system. He found that one of the most important points was to make the men interested in their work. He should be able to go back to his Directors strongly fortified in his desire to introduce the fittings business.

Mr. W. R. Davey (Newbury) said he agreed with most of the remarks in Mr. Watson's paper, but he thought the particular burner recommended (Bray's, No. 5) was too large for slot consumers, as they knew people were extremely careless in the use of gas. Mr. Watson said a gas company could not do too much to give satisfaction to their customers by recommending the introduction of incandescent gas lights. Why did he not supply incandescent burners to all his slot-meter consumers? In the town he (Mr. Davey) came from, all these consumers had been using incandescent burners for the last 2½ years; and they had given much satisfaction. In fact, he attributed to this circumstance much of the success attending that department of the business.

Mr. F. W. Cross (Lea Bridge) said he was a searcher after information; and he hoped to hear from other members the cost of the maintenance of incandescent gas-lights. The general price seemed to be about 9d. per burner per quarter. Mr. Shoubridge had mentioned that the Welsbach Company had given up maintenance; and he (Mr. Cross) had lately received an application, asking if he would undertake it now that the Company were relinquishing it, and offering him the same terms—viz., 1s. 6d. per quarter per burner, less 15 per cent., which was about 1s. 3d. per quarter. If the Welsbach Company could not make maintenance pay at that price, he did not see how they could afford to undertake it for 9d.; and it made him very reluctant to take up the business. Mr. Watson said that in giving incandescent burners to slot consumers he had gone a little in advance. But in his own case, in every slot installation, they gave at least one incandescent burner, mantle, and chimney complete; and they found this tended to promote the sale of other incandescent burners.

Mr. H. E. Riley (St. Austell) said it might be interesting to give the members some account of the sort of competition they had to meet with in small towns, and how the fittings business aided one to deal with it. When he went to St. Austell, about six years ago, electricity held the field entirely. The whole of the front street shops were lit by electricity; and the gas-works were supposed to be doomed. They took up the fittings business, and interviewed the people who used the light; but it was only by offering to put up lights in the shops for six months on trial, and agreeing to stand or fall by the result of the comparison, that they secured any amount of business at all. Through pushing the business in this way, they had practically got back nearly the whole of the customers who had been using electric light. The Electric Light Company secured business in the first place by a method which he had not heard of anywhere else. They went into the shops, asked for the gas bills for the previous two years, and then said they would put in the electric light (the same number of lamps) and charge 10 per cent. less. Of course, no gas company could stand competition of this kind. The Company found that this did not pay, and they had to introduce meters. Then the customers learnt that instead of electricity costing them 10 per cent. less than gas, it cost 50 per cent. more. The Gas Company then had their turn; and, by pushing business in the way described by Mr. Watson, they were able to get back a great portion of the custom. In fact, their increase in six years was 80 per cent., while the Electric Light Company had been in liquidation for three years.

Mr. J. H. Cornish (Bridport) asked if Mr. Humphrys could give some figures as to the cost of maintenance. From some experience he had had, he found the average number of mantles used for interior lighting was about 1½ per annum; so that, taking the cost at 4½d. each, the price of 9d. per quarter per burner paid them fairly well. The incidental advantages also ought to be considered. He did not agree with Mr. Humphrys that partial maintenance involved complication; he thought it was rather the reverse. To charge 3d. per burner per quarter, or 1d. per month, for

a monthly visit, was extremely simple; and they merely charged for anything supplied. The 3d. per quarter was for labour only.

[At this point the discussion was adjourned to the following morning, when it was resumed after the lecture.]

Mr. W. W. Hutchinson (Barnsley) asked if Mr. Humphrys had any experience of lighting places of worship on the incandescent system. He found one of the most vital points in the successful application of the system to these places was to have a separate main to keep the pilot lights going, independently of the ordinary main. He should like to know if either Mr. Humphrys or Mr. Watson had any special information on this point.

Mr. J. H. Troughton (Newmarket) congratulated the readers of these two papers on the very able way in which they had presented the results of their experience. Something like eight years ago, his Company commenced the fittings business; and it had grown to such an extent that to-day they turned over more money per annum in connection with it than the Electric Lighting Company did altogether. With regard to church lighting, he had fitted up three churches on the incandescent system, adopting the plan of having short pendants from the centre of each arch, fitted with No. 3 or No. 4 incandescent burners. They succeeded very well, and had reduced the lighting bill from £6 to £1 12s. per quarter, at the same time giving double the amount of light. For public lighting, they used exclusively incandescent burners; and last year they got through with an expenditure of 4 mantles per lamp. He should like to know if this was about the average.

Mr. H. Townsend (Wakefield) said he might answer Mr. Hutchinson's question by saying that they lighted Wakefield Cathedral with Kern burners, but without any pilot-light. They were lit with a torch, the same as an ordinary flat-flame burner; and the verger found no difficulty in doing it. He believed the Cathedral authorities were about to extend the system. The question of lighting churches and public buildings seemed to be a growing one; and during the past six months he had been in communication with churchwardens and others as to the lighting of several places of worship. One churchwarden told him that the light was so bad that, unless something could be done, the Vicar had determined to introduce the electric light. He could not persuade this gentleman to go in for the Welsbach system; but he took off all the old burners, and substituted new ones with economizer tops. After the first Sunday on the new system, the Vicar wrote that the improvement was wonderful; and if the bill was less, as it probably would be, he should be very much gratified. He (Mr. Townsend) had the curiosity to look up the bill for the next quarter, and found there was a reduction of 10 per cent. This was an example which reacted very beneficially in favour of the Gas Company. People attending the church noticed the improvement in the light; and when they learnt that there was a reduction in the bill as well, it all tended to keep out their competitors. The Company had also introduced the principle of maintenance of incandescent burners, though it had only been in operation about seven months, so that he could not give any accurate figures. It had, however, revealed one or two things which he did not expect—for instance that the careful people still looked after their own burners, while the careless ones came to the Company. He had had to write one or two rather strong letters to some of these people. [Mr. Townsend read one of these epistles as a specimen, in which he pointed out to the customer that he had used 22 mantles, and about as many glasses, in eight weeks, which cost the Company 21s. 4d., while their charge was only 5s. 4d.; so that they had spent four times as much as they had received, though, with proper care, the charge made—4d. per burner per month—was quite sufficient to pay expenses, and did so in the majority of cases.] He was glad to say that the letters had the desired effect, and rather than have the Company give up the bargain, the consumer exercised more care, and the expenditure decreased accordingly. They had lately been lighting a very exposed district with Welsbach burners, and the first lamps put up not being wind-proof, they had to apply copper gauze to protect them. They had now brought down the consumption of mantles to $3\frac{3}{4}$ per annum.

Mr. J. Lyne (Wexford) said there appeared to be a general agreement with the remarks of Mr. Watson; and he certainly could not disagree with him, seeing that he had the honour of reading a paper on the same subject at the Belfast meeting in 1893, when he urged that gas undertakings should take into their own hands the supply and maintenance of all fittings. Mr. Watson had made some very good points; but he had missed one or two. A very important thing to attend to in the supply of fittings was the size of the pipes, as, if they were not adequate, considerable service could be rendered to the consumer by advising him on this matter. It was the same with regard to pendants, some of which, such as the old-fashioned water-seal pendant, were positively dangerous. As a contrast from what Mr. Watson recommended, he happened to know of a small municipal gas undertaking in a compact town, with a population of 10,000, where the consumption of gas was much less than it should be—viz., only about 9 million cubic feet. But this was not to be wondered at when he told them that not only did they take no interest in the supply of fittings, but did not even provide meters, which the consumers had to buy for themselves. If this policy were reversed, he had no doubt the consumption would be doubled in three or four years. Mr. Humphrys had mentioned two or three kinds of burners, including the No. 4 Kern and the "C;" and he gathered that the former were fixed on the public lamps, and the latter on outside lamps used by private consumers. He should like to know why Mr. Humphrys did not use the same kind throughout, as he should think the Kern was far the better burner for outside purposes, where the greatest possible display was required. He also wished to know the respective charges for public lighting under the flat-flame system and the new.

Mr. A. Dougall (Tunbridge Wells) said he did not rise to criticize these papers, because he was in entire sympathy with them. He thought the time had come when all gas companies ought to have a department for the sale of gas, which should look out for new consumers, carry out the necessary fittings, and give information with regard to the consumption. In Tunbridge Wells they kept all internal fittings free from obstruction without charge, so that the consumer might always have an uninterrupted gas supply. There they had very strong competition on the part of the electric light. The new houses which were being built were wired very often for electricity, but no gas-pipes were put in; and he had to meet this by undertaking to do the work considerably under cost price. When he approached the builders, and pointed out the cost of piping the house for gas, he had no difficulty in getting them to agree to pipe their houses as well as to wire them; so that if the occupier, in a year or two, wanted to change from one system to the other, it could be done without difficulty. Mr. Humphrys had not given any figures as to the cost of maintaining incandescent burners. In his own case, they had been maintaining burners for nearly a year, and at the present moment had upwards of 1500 under their care, charging 9d. per quarter. He had taken out the cost of maintenance for nine months, and found they had made a loss of £10 in that time. They did not mind this very much, because he thought it was far better to give satisfaction to the consumer than to make a small reduction in the price of gas; and even if it cost £50 or £100 per annum to carry out the system, they would be inclined to do it. They did not stop there, but had started a similar system in connection with cooking-stoves and gas-fires; sending a man round to adjust the burners, examine and clean the stoves, and see that everything was in proper working order. By this means they saved many complaints, and gave greater satisfaction. A little expenditure in this way was really a source of income to the Company, because when everything was in good order, gas was used more freely.

Alderman Miles (Bolton) said if there was any doubt in the minds of members as to the desirability of attaching a fittings department to their undertakings, the sooner it was dispelled the better. For nearly 35 years they had had such a department at Bolton; and it had not only been a source of profit (at present it was about £1000 a year), but was an inestimable benefit in other ways, especially satisfying the consumers that the work done for them was of such a character that it could always be relied upon. The great difficulty in companies and corporations taking up fittings was that very frequently cheap work had been done of a very inefficient kind—pipes which were too small being put in, with the result that there was an inadequate supply of gas. Of course, all the complaints went, not to the plumber, or the gas-fitter who was at fault, but direct to the gas suppliers, and it was said that the gas was bad. With a well-organized fittings department, all these complaints were done away with at once. As to the use in public lamps of

incandescent burners, they had in Bolton at present, he thought, upwards of 1000 lamps of this kind; but he was sorry to say their experience had not been what they anticipated. They put up a few lamps which apparently did well under ordinary circumstances; and they rather indiscreetly ordered a very large number of what should have been windproof lanterns from the Welsbach Company. When, however, they were set to work in some districts where they were very much exposed, they were not a success; and the Committee were now endeavouring to improve them. He believed they were capable of it; and with a lamplighter who was careful in his work, they would act successfully. Here again they had had trouble, because he did not think the men had taken kindly to these burners. The old flat-flame burner was easy of manipulation, and gave little trouble; and the men did not much like burners which gave them more work. They were, however, improving rapidly in this direction. With regard to the upkeep of incandescent burners, it could not be denied that it was very necessary to undertake this duty; for, according to his experience; consumers desired every bit of trouble taken off their hands. He had a case in mind, in which a very good consumer, having a large shop, had incandescent burners fitted. It was all very nice for a few days; but when one mantle after another kept giving way, he said it caused too much trouble, He could not stand it; and he introduced the electric light instead. If gas companies and corporations would take this matter in hand, and see that the consumer was relieved of all trouble, he believed there was a great future for the incandescent light, especially under the new conditions. As to the price, it behoved gas managers to be on the alert, however, for the electric light people were straining every nerve to make it appear that their light was convenient, clean, and economical; and they were persuading many gas consumers to adopt it. Gas managers, therefore, must not go to sleep. If, however, the fittings business were taken in hand vigorously, he believed important results would attend their efforts.

Mr. W. Langford (Longton) suggested that the greatest nuisance in connection with incandescent street lighting was the present bye-pass. He should like to hear the opinion of Mr. Humphrys on this matter.

Mr. J. H. Buckley (Formby) said he had 120 street-lamps on the incandescent system, about 100 of which were lighted on the Bellamy, or Liverpool, system; but he regretted to say that the number of mantles used per burner had not been so low as Mr. Bellamy claimed—viz., a little under three per annum. Keeping them thoroughly up to date, he thought his average worked out to about six per annum. But even at this rate he did not consider it an extravagant item. Up to two years ago, they only supplied gas to the Town Council, and let out by tender the maintainence, cleaning, lighting, and extinguishing to a local plumber. This was not satisfactory to the Company, the Council, or the ratepayers; and they were about to make a change—in fact, they had gone so far as to appoint a fitter of their own, and were about to employ their own lamplighters. He thought this was an opportune time to get the thing into his own hands; and he approached the Council for the purpose, telling them the Company would prefer to undertake the whole work. After a little difficulty, they sanctioned the Company having the contract for one year. This was done, and he had had very few complaints since. He would urge all gas managers to adopt the same system, as it was much better to have the whole thing in their own hands, and thus be masters of the situation. The lamps which were not on the Bellamy system were a few Welsbachs and a few of the Pontifex make. The former had "C" burners; the others were on the Kern principle. He must say he did not like the pilot-lights, as they were a source of trouble, frequently going out and blocking; so he had abolished them, and now lit the lamps with a ladder. He had three churches lighted throughout on the incandescent system, and two partially lighted. Three were fitted with "C" bye-pass burners; but he should not recommend anyone to adopt this system of lighting, as it was always a source of trouble. With a little training of chapel keepers, there was no difficulty in lighting the lamps when they were required.

The President said the two papers were very interesting and practical ones; and he did not recall any discussion in which so many members had taken part. He had every sympathy with the objects set forth, although he had had no experience of maintenance, as other matters had occupied his Company's attention hitherto. But probably, in due time, they would fall into line with other towns which were adopting this system.

Mr. Humphrys, in reply, said he feared he had not been able to hear all the questions; but if he had missed anything, and it was submitted to him afterwards, he would answer it either privately or through the Press. With regard to church lighting, it had always been an important feature with him, as it was what shopkeepers would call "a good line." There was no dust and no vibration in churches; and the mantles lasted a long time—he should not like to say how long. In their district they had quite 80 per cent. of the total number of places of worship on the maintenance system; the reason they came in among the first being that the previous flat-flame lighting was extremely bad. For the most part, they used the old tripod fitting, with a fork on each side—something like a Prince of Wales's feather—and the light was very flickering and smoky. But when they once showed a church with about sixty No. 4 and No. 2 Kern burners, the improvement was so evident, and the light so brilliant and steady, that it at once attracted attention, and formed a capital advertisement for the system. He had given in the paper his reasons for preferring inclusive maintenance. He did not attach a great deal of importance to getting a low record with regard to the number of mantles used. He was not much in favour of records generally, because, though one might get a very low record, it had to be paid for, and it always involved a good deal of expense or loss in other ways. What was wanted was a good advertisement for gas lighting; and if they expended another £10 or £20 a year in mantles, and got a good advertisement for both public and private lighting, it was money well spent. Mr. West had been to America, and, like most people, had come back rather impressed with the slowness of English notions. Very possibly there was a good deal in what he had said. But England was not America; and he (Mr. Humphrys) fancied that if an up-to-date, smart American canvasser were to go round the precincts of Salisbury Cathedral, people would send for a beadle, and have him removed. At the same time, there was room for more to be done, in the way of pushing business, than had been accomplished. He had himself done much in the way of canvassing, but he had seen smart canvassing in other lines, and wanted to exercise some caution. If men were sent out with an inducement to get business, it was not always easy to keep them within the strict limits of "gospel truth;" and one was sure to hear of it afterwards. A strong point made by Mr. West was the isolated position of gas companies. In the South and South-West of England, they found this particularly the case. Thirty, forty, or fifty towns had been taken up by a large Electric Corporation, who had a head office, with a special staff of canvassers, and facilities for introducing and pushing business, giving estimates, and all that sort of thing, which was quite beyond the capacity of an ordinary provincial gas company. They wanted some organization by which they could get information as to what was being done in other places, and, if necessary, prepare estimates at a few hours' notice. In reply to Mr. Whatmough, he might say that he adopted the inclusive system almost entirely for the reason stated—that it gave him full control of the burners; and he was anxious to get as much control as possible. He thought it was fairly plain where the increase of 5 or 6 per cent. in consumption came from. It was well known to most people that, if the service were improved in any way, an increase of business would follow. As he had mentioned, a large part of the maintenance business was new—people who would not otherwise use an incandescent burner, or perhaps not have gas at all. They had at Salisbury been making progress in other ways, such as in the supply of cooking-stoves and slot-meters. Additional burners being sold, the extra consumption of gas naturally followed. In regard to anti-vibrators, he had not used them very much—perhaps one in twenty throughout the district. They had heavy traffic, however, including a large number of traction engines, which were often drawing long timber carriages carrying trunks of trees; and these were worse than any ordinary traction-engines. They had not, however, much trouble with mantles from that cause. The trouble at first was in isolated positions. For instance, one lamp-post was very near the entrance to a brewery, from which they were continually rolling barrels; and occasionally one would be rolled right against the post. In another place, where they had a number of broken mantles, they had to do a little private detective business; and it was found that about six o'clock every morning a servant girl used to come

out with her arms full of mats and rugs, which she proceeded to beat against the column. In one or two other cases, they found that people objected to having their premises so brilliantly illuminated; and they purposely damaged the mantles. In one case they had to call in the police. But this was all stopped in the course of the first year, and their troubles in that respect had ceased. On the bridge there was a good deal of vibration, it being rather loosely put together; and the gas-main was deflected about ¼ inch. They remedied this by means of the Clay-Walmsley coiled system, of which they had about a dozen in use. They also used the Welsbach anti-vibrator. They had no special trouble in other ways, though sometimes a steam-roller did damage when they were trying to make a concave road level by pressing down the sides. The next question was with regard to the records. These burners were slippery little things, and it was highly necessary to keep a reliable record of them. He had endeavoured to do this as far as possible, and found that the average for public lamps was about 5 mantles per annum; but for private lighting it was a good deal less—between 2 and 2½. Mr. Lyne had asked for some information as to the comparative cost of the present system and the old flat-flame burners. The latter cost the town about £900 per annum, and their tender, which was accepted, in 1898, was for £574; so that there was a saving to the town of nearly 50 per cent. But it was understood that if there were a saving the amount should be expended in additional lighting; and the consequence was that they put up 150 more lamps, and the outlay was now about £800 a year. He had a great deal of sympathy with what Mr. Miles had said about wind-proof lanterns. There was some difficulty at first in Salisbury, and they tried a good many of the lanterns recommended on this account, but did not find that they were really wind-proof. Some of the best results were obtained by just putting a little extra protection round an ordinary box lantern—a little baffle-plate in the top and a cone. In 1898 he did not know quite so much as he did now; and at that time the pilot-light was practically the only available system. But if he were beginning *de novo*, he thought he should adopt some other plan. However, they had them in use now; and having introduced the new system so recently as 1898, they did not wish to take all the burners out just yet.

Mr. WATSON, having thanked the members for their kind reception of his paper, said it did not pretend to bring forward anything particularly novel. It appeared, however, from what one observed in different places, and from the remarks which had been made, that nearly all the members believed in the advantage of the fittings business in the abstract, but that many of them did not carry out their belief in practice. Mr. West suggested enlisting the co-operation of plumbers and gas-fitters, by letting them sell what they would prefer to sell themselves. But he thought it must be obvious that an ironmonger had far more interest in the sale of an oil-stove for cooking than in the sale of a gas-stove, because he would hope to sell the oil which would be used with it. The same argument applied to other things, especially to oil-lamps. If they were to depend upon the trade, their interests would not be studied as they would be by their own fittings staff. The experience of those who had tried it, showed that the fittings business did undoubtedly pay for itself, not so much as a direct source of profit, but as a means of increasing the sale of gas. He must apologize to Mr. Lyne for having overlooked his paper on this subject; but as it was read about ten years ago, he hoped he might be excused for bringing the matter forward again. Some remarks had been made as to the desirability of supplying incandescent burners for slot-meter consumers; and probably Mr. Cross and one or two others had gone rather farther than he had in this way. In his case, unfortunately, the average slot-meter consumer was a poor one, and though the consumption was increased by the use of cookers in the majority of cases, the total average consumption from this class of customers was only about 10,000 cubic feet. Introducing incandescent instead of flat-flame burners, would mean an increased cost to the consumer in the way of renewals, which would be needed more in small cottages, where the space was restricted, and children came more in contact with everything in the room than they did in larger houses; and the cost of renewals might cause some of the people to think seriously over the question as to how far it was advisable to continue the use of gas. If incandescent burners were used for this class of business, he should go in strongly for maintaining the burners at the Company's expense; but to do so at 9d. per quarter would, he feared, be equivalent to adding 3d. or 4d. per 1000 cubic feet to the price of the gas supplied, which was rather a serious thing. Mr. Davey also questioned the wisdom of using a No. 5 Bray burner, with an economizer cap, instead of a smaller size. His idea was to give an all-round efficiency with a flat-flame burner; and from a number of tests of various burners and caps, he found that the combination mentioned served the purpose best. There was the additional reason that the caps might occasionally be removed by "scientific inquirers" in some of these small houses, who often evinced considerable interest in the details of the fittings, and sometimes even disconnected the meters. The removal of the cap would at once bring down the value of the light obtained from the burner; and if the cap were taken from a No. 3 or No. 4 burner, he was afraid a consumer would experience very little satisfaction with the light.

SUNDAY REST FOR GAS WORKERS.

By R. G. SHADBOLT, of Grantham.

The question of resting from labour on the Sabbath is one that, to all intents and purposes, was settled more than 3000 years ago. Yet such is the tendency of human affairs to contrariness and contradiction, that, in this most Sabbatarian of all countries, a large proportion of workers are, in this Year of Grace 1902, compelled to follow their particular calling, as though no Rest Day had been set apart. The charge of ignoring the Day of Rest lays heavily at the door of modern civilization; and our own industry, as one of the products of that civilization, has no doubt done much to justify the charge. Fortunately, this is becoming a thing of the past; for on reviewing the present situation, we find we have progress to report, as there are unmistakable signs of a movement in the right direction.

It is with great diffidence that I appear before you to-day as the exponent of such a venerable subject; and I can only claim your sufferance on the ground that circumstances have conspired to place me in this unenviable position. Indeed, the subject has been thrust upon me, rather than selected of my own free choice. It may be within the memory of some here present that the writer submitted an emergency paper to the members of the Manchester District Institution of Gas Engineers at their Southport meeting in November, 1900, entitled "The Minimizing of Sunday Labour in Gas-Works," which paper simply set forth his own attempts at "Sunday stops," how they were effected, and an estimate of the monetary loss entailed. This effort was favoured by a certain amount of attention in the technical Press, with the result that the late Dr. Gritton, an enthusiastic Sabbatarian, pressed the writer to extend the range of his observations, and give the Sunday Rest movement another fillip. Protests were useless. It was pointed out that the movement was slowly but surely gaining ground, and it might with safety be left alone; but all to no purpose. Certain well-known members of the gas profession joined issue with Dr. Gritton; and the writer eventually surrendered at discretion. A circular of inquiry was drafted, and issued to every gas undertaking in the United Kingdom, so far as the writer is aware. The circular letter and queries were as follows:—

Gas-Works, Grantham, October, 1901.

.....Esq.

Dear Sir,—At th. request of several gentlemen who have interested themselves in the movement for the reduction of Sunday labour in gas-works, I venture to ask if you will be good enough to let me have a reply to the following queries. By so doing, you will enable us to gauge the progress made, and bring statistics on the subject up to date. Thanking you in anticipation,

(Signed) R. G. SHADBOLT.

P.S.—If you have any objection to the name of your undertaking appearing in any summary that may be compiled, kindly endorse your return "Private."

QUERIES.

(1) Have you effected any diminution in Sunday labour at your gas-works, particularly in the carbonizing department?
(2) If so, to what extent?
(3) Assuming the character of your plant or local conditions to be such as to prohibit "Sunday stops," are you in favour of the movement?
(4) If not, why?
(5) Any remarks.

Signature.....

Date.....

It will be noted that the questions were as simple as could possibly be drafted, and such as little, if any, objection

CLASS A.—*Works Making up to 5 Million Cubic Feet per Annum.*

WORKS PRACTISING "SUNDAY STOPS."

No.	Duration of Stops, in Hours.	Remarks.
1	9	..
2	12 to 8.	..
3	9	..
4	12 to 8.	..
5	12	..
6	10	..
7	12	..
8	12	..
9	24 in Summer	..
10	8	..
11	12	..
12	12	..
13	12 to 6.	..
14	24	..
15	16	..
16	12	..
17	6	..
18	12 to 6.	..
19	12	New holder enabled to do this
20	24	..
21	12 to 6.	Insufficient storage prevents more
22	12 in Summer	..

PLACES "WORKING THROUGH."

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Inadequate plant, but reconstructing	Yes	..
2	Insufficient storage.	,,	..
3	,, ,,	,,	..
4	Does not say.	,,	..
5	Insufficient storage	,,	..
6	Plant too small throughout	,,	..
7	Insufficient storage.	,,	..
8	No reason given.	,,	..
9	,, ,,	,,	..
10	Insufficient storage, but minimize 50 per cent.	,,	..
11	Unsuitable plant	,,	..
12	Cannot stop quite, but minimize considerably	,,	..
13	Insufficient storage	,,	..
14	Plant too small	,,	..
15	Minimize	,,	..
16	Works small	,,	..
17	Tried once, and dropped heats	Do not say	..
18	Minimize	Yes	..
19	Deficient retort power	,,	..
20	Small plant	,,	..
21	Not given.	Do not say	..
22	Unsuitable plant	Yes	..
23	Minimize considerably	,,	..
24	Insufficient storage	,,	..
25	Works too small.	,,	..
26	Minimize	,,	..
27	Plant too small	,,	..
28	,, ,,	Do not say	..
29	Minimize	Yes	..
30	No reason given.	,,	..
31	Minimize	Do not say	..
32	,,	Yes	..
33	Insufficient storage	Do not say	..
34	Small plant	Yes	..
35	Insufficient storage	,,	..
36	Minimize	Do not say	..
37	Small plant	Yes	..
38	Insufficient storage	,,	..
39	Minimize	,,	..
40	Plant too small	,,	..
41	Minimize	,,	..
42	Insufficient storage	,,	..
43	No reason given.	,,	..
44	Minimize	,,	..
45	Small plant	,,	..
46	Minimize 50 per cent	,,	..
47	Small plant	Do not say	..
48	Insufficient storage.	Yes	..
49	Small plant	,,	..
50	Minimize.	Do not say	..
51	None given	,,	..
52	Insufficient storage	Yes	Putting in new holder which will enable to stop
53	Minimize	,,	..
54	,,	,,	..

could be taken to. The chief object was to ascertain in how many instances Sunday rest was afforded the stokers—for other classes of labour are rarely employed anywhere on the Sunday; also where no relief was afforded what the reasons might be, and, further, at how many works where no cessation of carbonizing took place on the Sunday, from one reason or another, were those in authority favourably disposed towards the movement.

No one is more alive to the general objection to the circular form of inquiry than myself. Yet this appeared to be the only practicable method of obtaining the desired end; and it is just possible that, in this particular case, the end may have justified the means. Moreover, as many people object to the names of either themselves or their places being published in connection with a general statement or summary such as was contemplated, provision was made to meet such scruples, and an undertaking given that the endorsement "Private" would be respected. As a large number of the returns were thus endorsed, all names of both individuals and places have been studiously omitted, not only in the general summary, but also in any abstract or quotation therefrom—except in two particular instances.

It may be here stated that at the time of issuing the inquiry, no fixed idea had been formed as to the manner of publishing the result. The number and nature of the replies have practically decided this point; for others beside the writer consider the replies to be so representative and instructive that it was decided to include it in the programme for the present meetings. One advantage this method of publication possesses over any other is the benefit of free and open discussion and criticism; and I trust that time will permit of this important subject receiving its full share.

So far as can be ascertained, a copy of the inquiry was sent to each gas undertaking in the United Kingdom—at any rate, 1600 were disposed of through the medium of the Post Office in October of last year. The replies came in quite freely at first, then gradually slackened, until they practically ceased. A quiet reminder by the technical Press brought in a few more. Yet another reminder, through the same channel, and by the end of March the replies had absolutely ceased. Altogether 443 replies were received from the 1600 inquiries sent out; these 443 representing 438 undertakings (more than one inquiry going to some of the larger concerns).

At first blush, the number of replies is rather disappointing—at any rate, when viewed in the light of the proportion they bear to the number queried—viz., 27·68 per cent. But a closer scrutiny quickly reveals the fact that they represent a far larger proportion of the total gas made in the country. In round figures, the total annual make of gas in the United Kingdom, including non-statutory undertakings, may be taken as 159,000 million cubic feet; while the annual make represented by the replies received is 106,000 million cubic feet, or 67·04 per cent. of the total gas made in the United Kingdom.

The replies divide themselves naturally into two sections—viz., those relating to works where Sunday stops are in vogue, and the reverse. Of the 438 undertakings replying, 218 stop gas-making for some portion of Sunday; and 220 do not—practically an equal division. Yet here, again, the gas make alters the complexion of things; for those works stopping on Sunday represent an annual make of 83,310 million cubic feet; being 78·14 per cent. of the total output of undertakings making returns, or 52·39 per cent. of the total output of the United Kingdom.

As the crucial test of the position of this movement is the number of workers obtaining relief, rather than the number

CLASS B.—*Works Making from 5 to 10 Million Cubic Feet per Annum.*

WORKS PRACTISING "SUNDAY STOPS."

No.	Duration of Stops, in Hours.	Remarks.
1	10	Practised stopping 20 years
2	12 for 8 months of year	..
3	9	..
4	6	Insufficient storage prevents longer stop
5	12	Stopped 20 years
6	12 to 6	..
7	18 to 12	..
8	18 to 12	For years
9	24 to 12	.
10	12 in Summer, 6 in Winter	New carbonizing plant in course of construction will enable longer stop all year round
11	12	..
12	4	..
13	12 to 6.	.
14	12	.
15	18 in Summer	Insufficient storage prevents stops in winter
16	12	..
17	12	..
18	6	Insufficient storage prevents longer stop
19	12	.
20	12	..
21	12	Restricted storage sometimes prevents stop
22	12	..
23	24 to 12	..

PLACES "WORKING THROUGH."

No.	Reasons or not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Minimize 50 per cent.	Yes	..
2	Insufficient storage	,,	..
3	,, ,,	,,	..
4	,, ,,	,,	..
5	No reason given.	,,	..
6	Insufficient storage.	,,	..
7	Men relieved in turn	,,	..
8	Insufficient storage.	,,	..
9	Minimize	Do not say	..
10	Insufficient storage, but minimize as much as possible	Yes	..
11	No reason given.	Do not say	..
12	Small plant	Yes	..
13	No reason given.	,,	Has stopped occasionally
14	Insufficient storage	,,	..
15	No reason given.	,,	..
16	Minimize	No	..

CLASS C.—*Works Making from 10 to 20 Million Cubic Feet per Annum.*

No.	Duration of Stops, in Hours.	Remarks.
1	12 for 9 months of year	..
2	6	Insufficient storage prevents more
3	12	..
4	12	..
5	12	..
6	12 to 8.	..
7	12 to 6.	..
8	24	..
9	12 to 6.	Insufficient storage prevents more
10	12 to 6.	Do., and cannot always stop in depth of winter
11	12	..
12	9	..
13	12	..
14	16 in Summer	Insufficient storage prevents winter stops
15	12	..
16	12	..
17	9	..
18	9	..
19	12	..
20	12	..
21	12 in Summer	Insufficient storage prevents winter stops
22	12 to 4	Do., and carbonizing plant prevents stops being of equal duration
23	12 to 4	..
24	12	..
25	12 in Summer, occasionally in Winter.	Insufficient storage prevents more
26	8	..
27	12 to 6	Storage only 70 per cent. of Max. output
28	6 to 4	Storage does not permit more
29	12 on 30 Sundays in year	Not favourably disposed
30	12 to 6	Insufficient storage prevents more
31	12	..
32	12	..
33	24 to 12	..
34	24 to 8	..
35	12	..
36	12	..
37	12	..
38	8	20 years
39	12	..
40	9	..
41	12 to 9	..
42	12	..

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Not given.	Yes	..
2	Insufficient storage	,,	..
3	,, ,,	,,	..
4	Not given.	,,	..
5	Men object	Do not say	..
6	Insufficient storage	Yes	..
7	,, ,,	,,	..
8	,, ,,	,,	Has tried but unsuccessful, means to try again
9	,, ,,	,,	Anticipating new holder, when means to stop
10	Do., but minimizes	,,	..
11	Deficient carbonizing plant	,,	Introducing regenerators, and then intends stopping
12	Minimize	Do not say	..
13	Tried and failed.	,,	..
14	Insufficient storage.	Yes	..
15	Insufficient storage and defective carbonizing plant.	,,	..
16	Small plant	,,	..
17	Insufficient storage.	,,	..
18	Unsuitable plant	,,	..
19	Insufficient storage.	,,	..
20	Minimize	,,	As far as practicable
21	Insufficient storage, but minimize	,,	..
24	Minimize, and men off in rotation	,,	..
23	Impossible	No	..
24	Minimize	Yes	..
25	Insufficient storage.	,,	..
26	Not given.	,,	Hope to stop shortly

of concerns granting it, we may safely place it on record that about 50 per cent. of the gas stokers of the United Kingdom at the present time enjoy a certain amount of extra rest on the Sabbath over and above that obtainable during the other days in the week. On the other hand, an approximately equal number must be assumed, from the returns, to be debarred that privilege, for reasons such as may be adduced from the replies received.

When the replies had fairly commenced to flow in, the writer was considerably agitated by the comments made by two gentlemen of extended experience in this matter, to the following effect: (1) "It seems to me to be very late in the day to be arguing possibilities in connection with this question;" and (2) "I am only surprised that there should be any question raised now-a-days as to the desirability or necessity for the adoption of such a policy." Never did one feel greater misgivings at anything yet undertaken. The unsavoury task of thrashing the proverbial dead horse seemed attractive in comparison. Nevertheless, as the returns show, there are still half the gas stokers of the country unaccounted for in regard to Sunday rest; and that in itself justifies the action taken.

Before introducing you to the tabulated returns, allow me to dispel the notion which appears to have permeated the minds of some gas managers—viz., that legislation was in view with the intent of making Sunday stops compulsory. Had such been the case, the writer for one would not have been a party to it. A few quotations may disclose this dread, and consequent disinclination, to reply. One gentleman declined to fill in the replies "because of the fear of organized movement to suppress Sunday labour, and the injurious effect it would have upon many over-burdened managers." Another: "Should strongly object to any scheme which included legislation in order to compel some

CLASS D.—*Works Making from 20 to 50 Million Cubic Feet per Annum.*

WORKS PRACTISING "SUNDAY STOPS."

No.	Duration of Stops, in Hours.	Remarks.
1	12	..
2	6	..
3	12 for 6 months of year	Insufficient storage prevents more
4	6 for Summer time	,, ,, ,, ,,
5	24 to 12	..
6	12 to 6	Insufficient storage prevents winter stops
7	12	..
8	16 to 12	Stopped 11 years
9	12	,, 3 ,,
10	16 to 8	..
11	12 to 8	..
12	12	When stock permits
13	24 to 12	Carburetted water-gas plant enables to do this
14	12 when possible	..
15	12	For the last 14 years
16	12	..
17	12 in Summer and minimize in Winter	Carburetted water gas assists
18	8	..
19	12 in Summer	..
20	12	..
21	Not given	But recently commenced
22	12	..
23	6	Storage interferes
24	12	..
25	12	..
26	12 in Summer and minimize in Winter	..
27	12	Over 15 years
28	12 in 6 months of year	..
29	12	..
30	8	..
31	12 in 9 months of year	..
32	12	..
33	24 to 12	..
34	12 to 8	..
35	10 to 6	Insufficient storage prevents more
36	24 to 18 fortnightly	..
37	12 in Summer	..
38	12 to 6	..
39	12	..
40	9	..

PLACES "WORKING THROUGH."

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Minimize 50 per cent.	Yes	C.W.G. plant assists
2	Not given	,,	..
3	Loss of stopping and starting	No	..
4	Insufficient storage and carbonizing plant	Yes	..
5	Insufficient storage and carbonizing plant	,,	Intends stopping when works extension complete
6	Insufficient storage	,,	Has occasionally stopped
7	,, ,,	Does not say	..
8	Circumstances against	Yes	..
9	Not stated	No	..
10	Minimize	Yes	..
11	Not in a position	,,	..
12	Unsuitable plant, relief gang every two weeks	,,	..
13	Plant too small	,,	..
14	Insufficient storage	,,	..
15	,, ,,	,,	..
16	Not stated	,,	..
17	Plant small	Does not say	..
18	Minimize	,,	..
19	Plant will not admit	,,	..
20	Not stated	Yes	..
21	Time-and-a-half Sunday pay	,,	..
22	Local conditions unfavourable	,,	..
23	Insufficient storage	Does not say	..
24	Minimize	Yes	..
25	Insufficient storage	,,	..
26	Works overtaxed	,,	But not on sentimental grounds
27	Not given	,,	..
28	Impossible	,,	..
29	Unsuitable plant	,,	..
30	,, ,,	,,	..
31	Do., but minimize	,,	..
32	Loss of stopping and starting, but minimize	,,	..
33	Not stated	,,	Has stopped occasionally
34	,, ,,	,,	..
35	Insufficient storage, but stokers get day off fortnightly in turn	,,	..
36	Insufficient storage	No	..
37	Minimize 50 per cent.	,,	..
38	,, slightly	Yes	..
39	,, considerably	,,	..

reduction in Sunday labour, &c." While on the other side another thinks: "That a Bill ought to be brought forward in Parliament to prohibit Sunday labour as much as possible, and compel gas authorities to provide proper plant and storage to meet this." Whatever inspired the notion of legislation, in the humble opinion of the writer it is absolutely unnecessary, as public opinion, and force of circumstances will in time effect the necessary cure. Inducement is preferable to coercion, especially during the transition stage.

Respecting the summary which now follows, not only have all names of places and individuals been omitted, but the actual annual make of gas of each concern represented has been carefully withheld. To enable comparisons to be made, and in order to give some idea of the magnitude of the respective undertakings, they have been classified according to their output within certain limits. Thus class "A" represents works making anything up to 5 million cubic feet per annum; while class "I," the last, includes annual makes of all over 1000 millions per annum—the intermediate classes taking up the intervals as shown. (See Plates I. and II.).

While dealing with the foregoing summary—in which, be it noted, the remarks, reasons, &c., are condensed—we will call those who stop on Sundays the "Yeas;" and those who do not, the "Nays." Kindly observe that the "yeas" and "nays" have been placed in juxtaposition in their respective classes, and thus form an interesting comparison. The column showing those in favour of Sunday stops is omitted on the "yea" side, as it naturally follows that those who practice the Sunday stop must, generally speaking, be in favour of it.

Turning our attention to the "yea" side first, we find from the remarks column that the Sunday stop is, comparatively speaking, an institution of some standing. Liverpool makes an easy first with its sixty years' record. Mr. William King's own words will, perhaps, best record the fact—viz.: "In 1843, or possibly earlier, my father, the late Mr. Alfred King, M.Inst.C.E., Engineer to this Company, introduced the system of eight-hour shifts for the stokers, and cessation of work for eight hours on Sunday. The works have been carried on ever since on this plan, of which I greatly approve. It will, therefore, be seen that Mr. Alfred King was the pioneer in the movement for the reduction of Sunday labour in gas-works; and the system of stopping the works for at least a portion of Sunday was first introduced at Liverpool." One may be permitted to add, "honour to whom honour is due."

The periods over which Sunday stops have been in vogue at different works whose representatives have been good enough to include this item in the replies, are as follows:—

Length of Time during which Stops have been in vogue.	Number of Undertakings who have practiced Sunday Stops over that Period.	Length of Time during which Stops have been in vogue.	Number of Undertakings who have practiced Sunday Stops over that Period.
60 years	1	15 years	1
40 ,,	1	14 ,,	1
35 ,,	1	12 ,,	1
30 ,,	2	11 ,,	1
26 ,,	1	10 ,,	1
20 ,,	6	5 ,,	1
16 ,,	1	3 ,,	1
Indefinite periods, as many years, &c.			10

A glance down the remarks column of the "yeas" shows that not all who practice the Sunday stop are able to do so all the year round; but on the principle that half-a-loaf is better than no bread, they do what they can.

Seasons of Stopping Other Than the Year Round.

	Undertakings.
Summer half year	22
8 months	5
9 ,,	4
30 Sundays in the year	1
Fortnightly	4
When stock permits	3
When possible	1

Possibly of greater interest still is the variation in the duration of stops, as shown by the following statement:

Duration of Stops.	Undertakings.	Duration of Stops.	Undertakings.
24 hours	7	12 to 8 hours	5
24 to 18 hours	1	12 to 6 ,,	12
24 to 12 ,,	6	12 to 4 ,,	3
24 to 8 ,,	3	10 hours	2
18 hours	1	10 to 6 hours	1
18 to 12 hours	2	9 hours	8
16 hours	8	8 ,,	18
16 to 12 hours	1	6 ,,	9
16 to 8 ,,	10	6 to 4 hours	1
12 hours	113	4 hours	1
12 to 9 hours	1	Not given	5

From this, it would appear that twelve hours is the duration in more than half the works practising Sunday stops, the eight hours making a very poor second, with a variation between twelve and six hours taking third place. Indeed, there is quite a consensus of opinion that anything beyond

CLASS E.—*Works Making from 50 to 100 Million Cubic Feet per Annum.*

WORKS PRACTISING "SUNDAY STOPS."

No.	Duration of Stops, in Hours.	Remarks.
1	12	For many years
2	8	Insufficient storage prevents more
3	12 for six months of year	Men paid for stops
4	12	Many years past
5	12	..
6	12	More than 30 years
7	12	..
8	12	..
9	24	..
10	Does not say.	Stops fortnightly as long as storage will allow
11	12	10 years
12	Does not say.	Stops as often as restricted storage will permit
13	12	..
14	24	Men are paid for stops which cost £130 per annum
15	12	..
16	6	..
17	12	..
18	12	..
19	24 to 8.	Expects greater regularity of stops from C. W. G. plant
20	12	Restricted storage compels working through occasionally
21	12	..
22	12 for 9 months of year	..

PLACES "WORKING THROUGH."

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Insufficient storage	Yes	..
2	,, relief shift fortnightly.	,,	..
3	Deficient plant	,,	Used to stop until plant became overtaxed
4	Insufficient storage.	,,	..
5	Minimize 25 per cent.	,,	..
6	Not stated	,,	..
7	Unsuitable plant	,,	..
8	Not in a position	,,	..
9	Not stated	,,	..
10	Men want paying for stop.	,,	..
11	Insufficient storage, but minimize	,,	..
12	Men want paying for stop.	,,	..
13	Not stated	,,	..
14	Thinks it would not pay	,,	Otherwise
15	Insufficient storage	,,	..
16	Not stated	,,	..
17	Minimize.	,,	..
18	Insufficient storage.	,,	Intends stopping when works extensions complete
19	,, and loss of stopping.	Neutral	..
20	Insufficient storage.	Yes	..
21	Not stated	Not gone into the matter.	
22	Local conditions and unsuitable plant	Yes	..
23	Insufficient storage.	,,	Used to stop till storage became inadequate
24	Thinks 8-hour shifts sufficient	,,	Provisionally
25	Insufficient storage and obsolete plant	,,	Hopes soon to be in a position to stop
26	Insufficien: storage but minimize	,,	..
27	Time-and-a-half Sunday pay.	,,	..
28	Not stated	,,	..
29	Insufficient storage and 8-hour shifts	,,	Would legislate
30	Time and-a-half Sunday pay, and 8-hour shifts	,,	..
31	Opposition too strong	,,	..
32	Minimize 50 per cent.	,,	..
33	8-hour shifts.	,,	..
34	Unsuitable condition of works	,,	..
35	Not stated	,,	Intends inaugurating Sunday stops

twelve hours is detrimental to the carbonizing plant. Of the 218 "yeas," two only furnish any particulars of cost. One in class "E" places it at £130 per annum; and the other, in class "H," fixes it at £1000 per annum. These figures, I presume, represent wages paid to men during the period of stoppage, and cannot strictly be said to have any bearing upon the actual cost of stops. In addition to those who suspend operations on the Sunday, there are a certain number who, unable to completely stop, contrive to minimize Sunday labour—from 50 per cent. downwards, according to circumstances. These number 45, and are entitled to some share of recognition; but for purposes of this communication, they must perforce be included in the "nays." In addition to these, there are a number on the point of inaugurating Sunday stops; others thinking of so doing; while some are only awaiting the completion of new and more suitable plant. These likewise are classified as "nays," but in a short time will have transferred themselves to the opposite side of the page.

In many respects the negative replies are more interesting than the positive, if for no other reason than that a large proportion of them express themselves as being in favour of Sunday stops, although various causes operate to prevent their adoption. This augurs well for the future of the movement. The proportions are as follows:—

"Nay" Undertakings	in favour of Sunday stops	181
,, ,,	not in favour of Sunday stops	11
,, ,,	neutral	4
,, ,,	indifferent or don't say	24

As an indication of the trend of feeling and thought in this matter, it is worthy of note that eleven only of all the replies display active opposition to the Sunday stop. The reasons adduced for no cessation of carbonizing on the Sunday are many and varied, as the beforegoing statement indicates.

Some Reasons for not Suspending Carbonizing on Sundays.

Reasons.	Number of Undertakings.
(1) Insufficient storage	60
(2) Deficient carbonizing plant	3
(3) Deficient storage and carbonizing plant combined	6
(4) Defective or unsuitable plant generally	35
(5) Extra pay for Sunday work	12
(6) Men want paying for stops	2
(7) Objection of workmen.	2
(8) Loss entailed in stopping.	6
(9) Because of 8-hour shifts	5
(10) Special local conditions	5
(11) Workmen relieved other days	3
(12) Carburetted water gas stopped instead.	3
(13) Reverted after two year stops	1

Let us now devote a little attention to these "reasons" *seriatim*, and in the light of the replies generally *pro* and *con*. Taking first that of insufficient storage, the majority of gas-managers would be astonished to find any other reason heading the list; for if there is one section of a gas plant allowed to become overtaxed more than another, it is that of storage. But whether or not it may in every case be regarded as a legitimate bar to Sunday stops, is another matter. Although sixty undertakings state that insufficient storage prevents them stopping, very few give particulars of the storage at their disposal. One in class "E," however, says: "The maximum day's output is 400,000 cubic feet, while the storage is only equal to 210,000 cubic feet."

It will be generally conceded that such inadequate storage accommodation is prohibitive of Sunday stops. Yet the following cases show what can be, and is, done in similar instances. A gentleman in class "C" says: "Storage two-thirds of maximum output. Yet manage to stop six hours and minimize six hours." Another, in class "F:" "Until recently, storage was only 500,000 cubic feet, with maximum output of 750,000 cubic feet, and yet we managed to do without Sunday work." A case in class "B": "When storage was only equal to half maximum day's output, we used to stop twelve hours six months of the year." And last, but not least, one works in class "D": "Stopped eight hours every Sunday for seven years with storage equal to 30 per cent. of maximum day's output." In fine, it may be taken as a safe rule that, given a sufficiency of carbonizing power, no more storage is required for Sunday stops than would be considered necessary for through working.

Deficient carbonizing plant is not pleaded by many; and possibly this as well as items Nos. 3 and 4 may be taken together—thus grouping all defective and unsuitable plant other than holders. Strange to say, our first quotation goes to show the unsuitability of new plant. One gentleman in class "F" remarked: "I find it very inconvenient to stop with inclines;" while class "I" contributes an instance of an up-to-date undertaking where the management consider it "impossible to stop." I venture to assert that the word

CLASS F.—*Works Making from 100 to 250 Million Cubic Feet per Annum.*

WORKS PRACTISING "SUNDAY STOPS."

No.	Duration of Stops, in Hours.	Remarks.
1	12	Many years
2	12	21 years
3	12 for 8 months of year	..
4	12	..
5	Not given	Insufficient storage hampers
6	12	..
7	12 Summer months	..
8	12	..
9	12	16 years
10	12	..
11	12	..
12	12 to 4	..
13	8	..
14	12	Minimized 30 years
15	12	..
16	12	..
17	12	..
18	12 fortnightly	..
19	24 to 8	..
20	12	Nearly 30 years
21	16 to 8	..
22	8	For the last 30 years
23	12	Many years
24	12	..
25	12	..
26	12	..

PLACES "WORKING THROUGH."

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Men prefer time-and-a-half Sunday pay	Neutral	..
2	Insufficient storage	Yes	Anticipates stopping when works extensions complete
3	Time-and-a-half Sunday pay	,,	Finds inclines less suitable than horizontals
4	Not given	,,	..
5	Unsuitable carbonizing plant	Neutral	..
6	Not given	Yes	..
7	Insufficient storage and carbonizing plant	,,	Intends stopping when works extensions complete
8	Time-and-a-half Sunday pay	Yes	..
9	Unsuitable plant	,,	..
10	Insufficient storage	,,	If stokers desired it
11	Do., and carbonizing power	,,	..
12	Minimize	,,	..
13	Unsuitable plant	,,	..
14	Men prefer time-and-a-half Sunday pay	,,	..
15	Stop C.W.G. plant and minimizes coal gas	Not altogether	..
16	Small plant, but minimize	Yes	..
17	Tried and failed, owing to loss of gas	,,	If practicable
18	Moving works, soon as complete, will stop	Yes	..
19	Men off in rotation one day per week	No	..
20	Not given	Yes	..
21	Insufficient storage	,,	Erecting new holder and then will stop 12 hours
22	Never tried stopping	Does not say	..
23	Minimize	Yes	..
24	Not given	,,	Putting in C.W.G. plant and hopes then to stop
25	Not convenient and 8-hour shifts	,,	When practicable
26	Insufficient storage	,,	..
27	Conditions render it impossible	,,	..
28	Men prefer to work	Neutral	..

CLASS G.—*Works Making from 250 to 500 Million Cubic Feet per Annum.*

No.	Duration of Stops, in Hours.	Remarks.
1	16 to 8 in Summer 6 months	..
2	16 to 8 for 9 months of year	..
3	16	..
4	16 to 8	..
5	Not stated	..
6	12	For 20 years
7	12	..
8	12	..
9	12 fortnightly	..
10	12	..
11	12 in Summer and minimize in Winter	..
12	8	Over 35 years
13	12	..
14	16 to 8	..
15	8	..
16	12	20 years
17	24	..
18	12	..
19	8	5 years
20	8	..
21	16 for 6 months of year	..

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Declined to say	Do not say.	..
2	Works unsuited	,,	..
3	Afraid of loss	Yes.	Provisionally.
4	Time-and-a-half Sunday pay	,,	..
5	Inconvenient in summer, impossible in winter	Only to extent of minimizing	..
6	Stop C. W. G. plant instead	Yes.	..
7	Insufficient storage	,,	Expect new holder will permit 8-hour stops
8	Does not say	,,	..
9	Stop C. W. G. plant instead	,,	..
10	8-hour shifts and time-and-a-half Sunday pay	Not specially	Abandoned stops after two years' experience
11	Not stated	Yes.	..
12	Extra Sunday pay, and experience of a few week-end stops	No.	..

CLASS H.—*Works Making from 500 to 1000 Million Cubic Feet per Annum.*

No.	Duration of Stops, in Hours.	Remarks.
1	12	..
2	16	..
3	12 in Summer	..
4	8	Insufficient storage permits more
5	16	..
6	6	Many years, and men paid
7	12	Estimated cost £1000 per annum
8	12	40 years
9	12 in Summer	..
10	16 to 8	..

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Loss of gas when stopping	Yes.	Stop C. W. G. plant
2	Not stated	,,	Made an attempt and intend trying again
3	Insufficient storage	,,	..
4	,, ,,	,,	Intends stopping soon as extensions complete
5	Not stated	,,	Hope new works now in hand will permit of stops
6	Local conditions prohibit	,,	..
7	Not stated	,,	Intends inaugurating Sunday Stops
8	Insufficient storage and direct-fired settings	,,	..

CLASS I.—*Works Making More than 1000 Million Cubic Feet per Annum.*

No.	Duration of Stops, in Hours.	Remarks.
1	12	Since 1876
2	16 to 8	..
3	8	Since 1843 or earlier
4	16	Many years
5	12	,, ,,
6	16	..
7	16 to 8	..
8	8	..
9	8 in Summer 6 months	Many years
10	16 to 8	12 years
11	8	..
12	8	..

No.	Reasons for not Stopping.	In Favour of Sunday Stops.	Remarks.
1	Insufficient storage and double Sunday pay	Do not say	..
2	Impossible, also extra Sunday pay	Yes	

"impossible" cannot be found in any other connection in the vocabulary of the gentleman responsible for this statement; nor can the plant, by any stretch of the imagination, be deemed either defective or unsuitable. A willing mind is undoubtedly a prime factor in this as in many other matters; the imagination also has here some little play. What more illogical, for instance, than to imagine that, because Sunday stops are impracticable in some cases at the season of maximum output, they are of necessity out of question for the remainder of the year? And yet many works are conducted on this assumption. One other instance in class "I," as a set-off to the last—and this from the pen of an old hand of over twenty-five years' experience in Sunday stops: "There are no conditions which appear to prohibit Sunday stops which cannot and ought not to be overcome."

Items 5, 6, and 7 may well be classed together, as they are to a great extent inter-dependent. It is generally admitted that the effect of extra pay for Sunday work is to make that day's time the best kept in the whole week; and where extra pay is in vogue, it is a most powerful factor against the introduction of Sunday stops. Take the evidence of an engineer in class "F," who had previously practised Sunday stops. "The men are as hungry as wolves for time-and-a-half Sunday pay, and are now opposed to stops on that account." That is a sample on the one side, and the following on the other, class "E:" "The advantage of Sunday stops is in keeping the men in full work during the remainder of the week."

The paying of wages for the Sunday stop has likewise proved, in many instances, to be misplaced generosity. Why a man should be paid for work he is not called upon to do is somewhat of a puzzle. Yet there are large-hearted gas managers who, when introducing Sunday stops, have left the week's wages intact—unfortunately at times with disastrous results. One instance of this in class "C" will suffice: "We arranged for a cessation of work for twelve hours every Sunday, except in case of emergency. The men were to be paid the same weekly wages as before. The arrangement worked very well until we asked them to come in for one Sunday on account of low stock. They declined to do so without extra pay. This was eventually granted; and now, as far as they can, they make it impossible to run over Sunday without charging, so that they may have extra pay."

However carefully one may arrange, circumstances will at times arise to cause working through on the Sunday; and as in the foregoing case paying for stops almost necessarily involves extra pay for working, a gratuity of this kind is merely another way of placing a premium upon Sunday labour. It may and will ensure a good muster of men, at the same time it provides many of them with the wherewithal to pay due obeisance to "St. Monday," as one engineer facetiously terms it.

Six gentlemen allow the fear of monetary loss to influence them in this matter; and methinks there are others beside. One engineer in class "E" feels that "under present-day conditions of keen competition, the additional cost of standing on Sundays is a disadvantage, unless electrical undertakings can be made to provide sufficient accumulators, and let down similarly." Another in class "G" "holds back because of working loss sustained by some large works that partially do away with Sunday labour." And another in class "H" "considers the wear and tear on machinery and plant is increased by Sunday stops." On the other side, we have an undertaking in class "G" where they "consider there is a financial loss. But the men benefit; and it enables shifts to be changed without overtaxing the men." While another in class "C" "finds it to be no loss to curtail Sunday labour." An instance from class "D," where they had "stopped three years and found commercial results to be entirely satisfactory." Yet one more comment, as this feature cannot be emphasized too much. An engineer in class "I" says: "The cessation of work on Sundays is beneficial to both workmen and employers; and being so, is obligatory on all Christian people connected with the industry."

The loss entailed, and the benefits obtained, are somewhat difficult to express in money value; and as the replies on the whole do not contain suitable material for forming a general estimate, allow me to speak from my own experience only. In the paper previously mentioned, on the "Minimizing of Sunday Labour in Gas-Works," the author gave an estimate of the items of loss (obtained from actual work over a period of twelve months) entailed by stopping and restarting, which estimate works out at £1 7s. 10d. per million cubic feet of gas made. Several friends who do not practice Sunday stops have questioned the accuracy of this estimate; but careful comparison over almost two more years has shown that the estimate is rather over than under the average loss entailed. A reference to the wages-book revealed a most agreeable surprise; for the three years during which we have practised Sunday stops, the carbonizing wages per unit of gas made have been coming down. This comparison of the three years is all the more valuable as, during the period, no change has been made in the rate of pay, nominal amount of work done, or general conditions. The three years work out as under:

Carbonizing wages per million,	1899-0 ..	..	£9 13 8
,, ,,	1900-1 ..	..	9 11 1
,, ,,	1901-2 ..	..	8 5 6

This shows a diminution of £1 8s. 2d. per million cubic feet of gas made, which is due entirely to better work done, which, in its turn, is largely the result of the beneficial effects of Sunday rest upon the workmen. In all fairness, then, it must be admitted that, given time to show themselves, the benefits derived from Sunday stops are equal to the loss entailed, even if they do not outweigh it. The first year or so is evidently the time of greatest loss, and, as in a change of plant or any innovation, some time elapses before everything is running smoothly in the new groove, but once all concerned are familiarized with the changed conditions, Sunday stops can be made to pay their way.

The eight-hour shift would, at first sight, appear to lend itself to Sunday stops. Yet, despite its adaptability, it does not seem to be always taken advantage of. Some managers argue that there is no necessity for Sunday rest with this system of working, as the hours of labour per week of seven days are less than those worked in six days with the twelve-hour shift. As one gentleman in class "D," who "considers the eight-hour shift arrangement better than Sunday stops," and several others in the same vein, some of whom claim that each shift gets Sunday rest once in three weeks, overlooking the fact that to obtain this they must get through 50 per cent. more work on each of the two remaining Sundays, than they would in an ordinary working day. This is one of the finest examples of self-deception that the inquiries have elicited.

Special local conditions form an obstacle in five cases; and as a pursuit of this form of objection might lead us into great uncertainty and misapprehension, we will rest content with acknowledging the great variety of conditions under which the gas industry is carried on, and the possibility of some of those conditions being quite prohibitive of any systematic cessation of manufacturing operations. The relieving of men in rotation, and on days other than Sunday, has its champion in our old friend and Past-President, Mr. Valon. His following, however, is not large, consisting of two beside himself, as against 218 who stop—*i.e.*, so far as these replies extend. There appears to be no especial reason why these particular places should not stop (say) twelve hours on the Sunday, instead of a certain number of men being off each day in turn. No more men would be required. and confusion would be avoided. What gas workers require in common with all others is a cessation of labour on the Sunday, not a holiday whereby they may further deplete their already attenuated physical resources, but a day of rest in which they may recuperate, both physically and morally.

The next reason given for not suspending gas making operations on the Sunday, is one connected with the use of carburetted water gas. There are several instances of carburetted water-gas plants in course of erection which, when complete, the users hope will enable them to effect Sunday stops. Again, there are others who have already utilized them for that purpose. But it was little less than an eye opener to the writer to find that in five cases this, the handiest of all plants should be put to the shameful purpose of keeping the coal-gas stokers employed full seven days per week. Or, in other words, in these five instances the carburetted water-gas plant is shut down on the Sunday, that the coal-gas manufacture may continue without interruption. Really, it is high time this homicidal homage to the Moloch of uninterrupted working came to an end.

There are several instances of works where Sunday stops have been abandoned. In every case, save one, this was forced upon them by the demand for the gas increasing so rapidly as to quite outgrow the capacity of the plant; but in one instance, and in one instance only, has a real reversion taken place—the prime factors being the introduction of the eight-hour shift, and extra pay for Sunday work. The influence of both these factors has been already touched upon.

Having reached the end of our tabulated list of reasons assigned for not stopping gas making on Sundays, let us spare a momentary glance at a small but peculiar section, whose especial duty would appear to be to find employment on the Sabbath for those under their care, that no desecration may ensue. We will refrain from quoting them; but the general idea of these gentlemen seems to be that the men actually benefit by being kept employed. When the question of throwing them out of employment one day in seven is mooted, the poor men's opinions are given every consideration (if against the project). Indeed, the fatherly concern of those gentlemen for their employees is touching in the extreme. Would such importance be attached to the men's opinion on, say, a matter of works alterations, or the selection of coal? I wonder!

Here and there, when diving among the returns, one comes across a disappointed wail, that the men do not seem to improve much morally, &c., &c., and in one instance they even had the audacity to laugh when informed of their duty in attending a place of worship. Let us be reasonable. Men who have been released from the most arduous toil a gas worker is called upon to engage in, must not be expected to immediately metamorphose from the human to the angelic plane. That they do benefit is an undoubted fact; a little patience being the only requisite to prove the statement.

One gentleman in class "D" "Thinks, judging from his own experience, that in small works the benefit is more sentimental than real, and more work and worry are placed upon the manager." This may be quite true at first, but once the system of stops is properly established, the extra work and worry upon the foreman or manager will disappear. A manager in class "C" says: "The men are more cheerful and less irritable under Sunday stops; but their appreciation is divided between rest and pay." Two other instances, in classes "F" and "G," find that the work is better done after a stop, and better time is kept during the six days than when working seven. There are others who take a loftier view of the question. One in class "D" "Would have the men treated as we should like to be treated ourselves;" while another in the same class looks upon the question as "one of right and wrong." In fact, the whole matter is summed up in the words of one engineer in class "I" who designates it "A plain duty."

One word to those who have attempted the introduction of Sunday stops, and for one reason or another have failed to make them a success. There are several such represented among the replies; and it is pleasing to note that most of them intend trying again. With care and discretion, they are bound to succeed, save under exceptionally adverse circumstances. The difficulties attending an occasional or compulsory stop should not be allowed to prevent a fair and lengthy trial, which would, in almost every case, prove beneficial all round.

Another comparison, and we have done. The notion has somehow got abroad that gas undertakings owned by local authorities are not as ready to grant "Sunday rest" as those in the hands of companies and private owners. Possibly the following analysis will serve to dispel this idea. Of the 218 undertakings returned as practising "Sunday stops," 161 belong to companies and private owners, while 57 are the property of local authorities—being approximately 74 per cent. to companies and private owners, and 26 per cent. to local authorities. Compare this with the relative proportions over the whole of the undertakings throughout the United Kingdom, and the stigma is immediately removed, for 83 per cent. belong to companies and private owners, and 17 per cent. to local authorities.

Reverting once more to the paper contributed by the writer to the Manchester District Institution of Gas Engineers in November, 1900, the *modus operandi* there detailed is still followed, save that the primary and secondary air ways are closed at the time the last round goes on before stopping, instead of three hours later. This has the double effect of reducing the coke consumption during the period of stopping, and tails off the gas make without materially affecting the quality. At the risk of being charged with the unpardonable offence of repetition, let me add that plant unsuited to the purpose of Sunday stops is synonymous with expensive working generally, and the sooner it is displaced the better; while the plant that gives the best working results is usually that most adapted to Sunday stops. Or, in other words, unsuitable plant means loss, and good plant leaves little, if any, excuse for working through on the Sabbath.

In conclusion, I beg to tender my heartiest thanks to those gentlemen who took the trouble to reply to my circular of inquiry, and express the hope that our united efforts may ere long result in the full working Sunday becoming the exception, and a substantial cessation of labour on the day of rest the general rule.

Discussion.

Mr. J. West (Manchester) said they must all be much obliged to Mr. Shadbolt for bringing forward this subject, and especially for the way in which he had done it. Some of the older members would recollect that it came forward about thirty years ago, and he then thought it was thoroughly threshed out—being then brought prominently before them by Mr. Morton. At that time a Committee was formed, and questions were sent out similar to those which had been recently issued; and the answers received were some of them similar and as lame as those they had just heard. At that time some managers considered as insurmountable difficulties what others gave as reasons why they were able to carry out a reduction in Sunday labour. To-day they had the same old excuses. One gave as a reason that he was deficient in gasholder capacity; while his neighbour gave that as a reason which enabled him to reduce Sunday labour. One said if he desired to make gas all day on Sunday, he could not possibly do it, as he had no place to store it. Many of them were at that time thoroughly convinced that there were no difficulties in the way—if certain arrangements were made in connection with the apparatus—for reducing Sunday labour. He started to reduce it, and he was rather surprised to find, according to the paper, that so few had continued it; but he believed there were a larger number practising this method than appeared. But whether this were so or not, he was one of those who started it in 1871. The difficulty then was how to do it; but when they were convinced it should be done, ways and means were found. Some of them thought there would be difficulties with the Directors, as they did now; the great question appeared to be whether it would reduce dividends. In his own case, his Directors helped him as far as posssible; and he told them he hoped it would not reduce the dividends. The result was that the year's working turned out better than ever before. Looking at the question morally, he certainly thought the men should have a day of rest. It had been proved over and over again that tramway horses were all the better for a day's rest, and he thought it was a moral obligation devolving upon every one to endeavour to give his men a similar rest, if possible. It was nothing to do with them whether the men went to church or chapel, or what they did. They should at all events have the opportunity; and it would remain with them to decide how to employ the time. The responsibility for this was not upon the manager. He (Mr. West) was satisfied it was the right and proper thing to do, and was only surprised to find that it was necessary to bring the subject forward again, and especially that so few had taken it up in the way they ought to have done. Possibly the younger members might not know very much of what took place in the past; but if they would refer to the "Proceedings" for 1870 and 1871, they would find various hints given as to how to arrange their apparatus to this end. He started it at Maidstone, and had no difficulty at all with his Directors; and when he went to Manchester, some 23 or 24 years ago, he brought the matter before the Corporation, and had no difficulty with them. They said if he could see his way to carry it out, he was to do so. He did see his way, and carried it out, though he was bound to say that it entailed no Sunday rest for him for a long time, for he had to drive in every Sunday to look after the apparatus, and see that things were going on properly. Why should they work fourteen shifts a week to make a dividend? If they could give as much of the Sunday as possible to the men, they would have more vigour in the week, and he thought the Trade Unions would assist. He did not much believe in the idea of men making time-and-a-half, and trying to force it on the managers to get money. The idea of the Trade Unions was to punish them, so as to force them to give the men the day's rest. As a rule, he found that when men had had rest they appreciated it so much that they did not like to be called in to work, even in cases of necessity. His difficulty at Manchester was with the men, because they had been accustomed to give them a holiday once a month, and pay them for it; but this was no reduction of Sunday labour. They got in extra men and paid them. They had to give this up, because they could not afford to pay men when they were

doing no work. He was not satisfied that anyone would be able to show a profit out of this thing, by a debit and credit account; but he would not accept this as the criterion, because there were so many collateral advantages one could not possibly put into £ s. d. But he could bring his Maidstone experience forward, which showed that the first year he tried the change was the best he had had up to that time, although the conditions were in every respect very similar to what they had been before. He considered it was incumbent on them all to try to carry out this plain duty, which had proved so successful wherever it had been tried; and he was sure that the paper would do a vast amount of good.

Mr. J. Carter (Lincoln) joined Mr. West in congratulating the Institute on having this question so well put before them by Mr. Shadbolt. In an early part of the paper, he said he was dealing with a subject which was practically decided three thousand years ago; but he had brought it before them in such a way that it had lost none of its interest, and it would give them all an opportunity of reconsidering their decision, if their feeling with regard to Sunday stops had not been sufficiently favourable. Those who had not given it the sympathetic consideration it deserved would probably be induced to do so. He could only speak from the experience of four or five years. They stopped for twelve hours on Sunday for about ten months in the year; but, looking at the figures relating to Mr. Shadbolt's own experience, he could not understand how it was he made a profit out of it. He had never looked upon the subject as one in which £ s. d. was the principal factor. One result of stopping on the Sunday was that the first shift after the stop was just the one in which the carbonizing was the least satisfactory; but this was practically the only thing which was against the general principle embodied in the paper. Some thought the objection to Sunday rest lay with the men; but he was bound to say (supporting Mr. West's experience) that the men would rather have the day off at ordinary pay than come and put in four charges on Sunday and get time-and-a-half. It was due to the men, where they were working twelve-hour shifts and changing every fortnight, that everything should be done to prevent that long, arduous, and anxious eighteen-hour shift. To him it seemed to be a matter of common humanity which all would readily recognize. In the case of those who did not cease on Sunday, it was not because they did not wish to do so, but because their local conditions were such that they could not safely do it. It was easy for those who enjoyed a fairly regular demand, which could be estimated with a nicety 24 hours beforehand, to arrange to stop work on Sunday; but there were others who were subject to unexpected and suddenly increased calls; and it was not to be wondered at if their anxiety led them to do a little work on Sunday, because they would not otherwise feel safe. He thought, however, that gas stokers should be like the rest of the working population, and enjoy the same privilege of resting from their labours one day a week. In order to do this, they only had to go on under ordinary conditions with 13½ instead of 14 shifts a week. He must conclude by congratulating Mr. Shadbolt on the paper, and also (though this was a digression) on the work he had done on the Council the last three years. He regretted that limitations of time compelled him to retire from the Council just when the negotiations with which he had been so intimately connected were being brought to a successful conclusion.

Mr. T. H. Martin (New Barnet) also thanked Mr. Shadbolt, and said his experience was very different from Mr. Carter's. They worked the twelve-hour shift, and stood off for twelve hours on Sunday; but he had never found the slightest reduction in the make of gas on re-starting.

Mr. Isaac Carr (Widnes) said that he was transgressing against the arrangement which it had been said was made some three thousand years ago; but still he was very much interested in the paper, though he differed from many of the conclusions arrived at. Some of the information which had been so ably laid before them by the author showed what a shocking bad effect on the stokers themselves the closing up on Sunday had had. He had told them of one case, where a generous manager gave his men Sunday rest and paid them their wages. When later on he wanted them to come to work they demanded extra pay, and subsequently they tried to arrange the work so that extra pay should be enforced. This was one instance which showed how much better off that particular manager would have been if he had never adopted Sunday rest. He (Mr. Carr) claimed to make gas fairly economically; but he had not introduced Sunday rest. He left it entirely to the men themselves. They did not work twelve-hour shifts, and have eighteen hours' change; and he thought, in cases of this kind, some consideration was necessary. For those who worked eight hours and had the third Sunday off (which the author described as a deception), was better for the men; they did more work and got 50 per cent. more money. Managers in various parts of the country viewed this matter in an entirely different light; and it was impossible to lay down a general rule for the whole kingdom. Whatever others did, he should continue to do what he considered fair to the men and most suitable for himself.

Mr. E. Jones (Pontypridd) remarked that Mr. Carr had said exactly what he should have liked to say, for he was also one of the transgressors. He had studied this question for the last two years, and he certainly had the impression that he would give the Sunday rest. Everything on the works was in favour of it; but he had the twelve hour system then, and he said there ought to be some distinction between the men working eight hours and those working twelve. In places working fourteen shifts the men certainly deserved some consideration; but with eight-hour shifts he considered it was hardly necessary. He thought if the men were consulted about this matter there would be a great deal of opposition. No doubt the author was in an enviable position, as he was not troubled with strong Trade Unions or living in a colliery district where labour was very scarce. Again, with the eight-hour shift, a man had a full twenty-four hours' rest; but his experience was that the men did not take rest. It was really a day of recreation, and of a very disagreeable kind; and the more holidays they had, the less fit they were for work. Again, with regard to additional pay, he should be opposed by the men if he gave 30s. instead of 35s. a week; and it would have an adverse influence on the home comforts. In his case, a man every third Sunday had sixteen hours off, and he was more fortunate than many. They had heard a great deal lately about advice to the young and the rising generation; and certainly they would have to add another plank to their platform if all young managers had to take so much into their hands with regard to the Sunday question.

Mr. J. A. Harris (Great Wigston) said Mr. Shadbolt had stated that circumstances had placed him in an unenviable position in having to bring forward this paper; but he (Mr. Harris) thought the subject was one quite worthy of him and of the Institute. This discussion could do nothing but good, though the subject was one they heard a good deal about. It ought to be brought home as a matter of personal responsibility to every gas manager. Did the men need rest? He thought there could be only one answer to that question. What was the effect on a man's life and character, as a husband and father, and as an employee at his work, if he seldom or never got the opportunity of spending the Sabbath in his home with his wife and family, or of attending a place of worship? There were more dividends to be considered than the one declared in the balance-sheet. In his younger days, when he was at a small works, he had to work daily all the year round; and the effect on his own life was anything but good. He believed in personal experience, and this had taught him that to spend the Sabbath as it should be was an immense advantage. Naturally, the question occurred to him: What was he going to do for the men he employed? If rest on the Sabbath day was a good thing for him, why not for his men also? There was a good deal too much of the money question in this matter. To his mind, the responsibility was very great; and he could not shake it off. He did everything in his power to do away with Sunday labour. They had managed for ten months without it, and worked four or five Sundays when it was absolutely necessary. He was glad the subject had been introduced; and he could not but believe that if anyone went into the thing with a will, there were ways of carrying it out. In the end, when a man was convinced that his master meant to do well by him, he would work with more efficiency. He (Mr. Harris) might say that since he had given up Sunday labour, several of his men had become members of Christian churches, and enjoyed the Sabbath as they should do.

Mr. C. Stafford Ellery (Bath) said he was sorry to hear the opinions which Mr. Jones had expressed, coming from Wales, which he had looked upon as a Sunday closing district; but he hoped Mr. Jones would live to regret the views he had put before the meeting. He should like to ask if Mr. Shadbolt knew a single case of a manager, who

had really given Sunday closing a fair trial, and had reverted to Sunday working. He could speak from about 22 years' experience of closing gas-works on Sunday, and he might say frankly at starting that his one effort every year had been to get one more Sunday shut up rather than have one more Sunday at work. With regard to the returns, he might say equally frankly that the figures made up on Monday morning, which had reference to Saturday, and a few hours on Sunday night, were invariably better than those for the other days of the week, whether taken per ton of coal carbonized or per mouthpiece, for the hours the retorts were working. He gave his evidence for the benefit of those who were hesitating; and he could assure them that they need have no fear of their returns falling off, either for the coal they used, or for the hours they worked. He noticed, in looking down the list of answers, that the chief excuse for Sunday working appeared to come from works where they said the plant was insufficient—either the gasholders or the retorts. He thought this was altogether a myth, for this reason: If they had retorts enough to produce the maximum day's make in winter, surely they had sufficient to let an extra two or three be on through the week to make the gas necessary to fill up what was not made on Sunday. He could understand managers who were overtaxed in the winter saying they could not stop work in December. They did not do this in Bath—they were sorry they could not; at other times it was simply a question of having a few more retorts working six days a week than were necessary on those six days, so as to make up for the deficiency on Sunday. With regard to gasholder capacity, if they had not enough to stock the whole of a day's make, there might be a difficulty. But there were very few works that could not stop on Sunday, even with very limited gasholder capacity. They worked eight-hour shifts, and stopped sixteen hours during eight or nine months in the year. The men left at 5 o'clock in the morning, and commenced making gas again at 10 p.m. As to the men themselves, when they used to work twelve-hour shifts, and have one Sunday off in three, they were as keen as possible to know when the Sunday was coming when they would have the whole day off. When he had to go to the works on a Sunday, when the men were making gas, and compared it with the condition of things when it was all quiet, as it should be, he did feel that it was a duty they owed the men to make it possible for them to have this day—however they might use it—when they need not be begrimed, in more ways than one, but when they might remain outside the works with clean clothes on.

The PRESIDENT asked if the men's pay was deducted for the time they were off.

Mr. ELLERY said it was; but, in his judgment, the men really lost nothing, the rate of wages having gone up. They now had 5s. 3d. for eight hours, six days a week.

Mr. H. TOWNSEND (Wakefield) said he was entirely in sympathy with the author of the paper, and, as far as possible, he gave the men the Sunday off. He noticed that one gentleman in Class F, said he found it very inconvenient to stop on inclines; and he himself had a little misgiving about it. But he found, by a little experience, that they could stop with inclines quite as easily as with horizontals. Though their retorts were not in very good order, he did not find that letting them down on Sunday did them any mischief. Mr. Shadbolt had referred to a paper he read to the Manchester District Institution, in which he set forth the methods he adopted for stopping his retorts. At that time he (Mr. Townsend) took the liberty of pointing out that if he had good chimney dampers it would simplify the matter very much. All they had to do at Wakefield, was to partially close the chimney dampers. They did not touch the primary or secondary air slides or bench dampers. Another gentleman who was in Class E (a small works) said he thought that the hardship was more sentimental than real, and that Sunday stops made more work for the manager. He (Mr. Townsend) was bound to admit that more work was placed on the manager; but he thought very few would begrudge some little amount of extra anxiety, when it conferred so great a boon on the men. His own men, though they did not get paid if they were not working, were very desirous of having Sunday off. There was no doubt that many of them did appreciate the opportunity of getting to a place of worship, and of spending the day with their families; and they ought to have this opportunity, even if it cost the undertaking something, and gave the manager a little trouble.

Mr. R. PORTER (Elland) thought the masterly manner in which Mr. Shadbolt had brought this important question before the members was worthy of all admiration. There were only two points to which he wished to refer, the first being the question of storage. He had been partially stopping on Sundays for more than six months with inclined retorts, and his experience was that actually less storage was required; and he believed the experience of others would corroborate it. The reason was that a manager must necessarily have a larger number of retorts under fire if he stopped on Sunday, and consequently the same storage was not required to take up the quantity of gas made on the day when a smaller number were used. The next matter was that of cost; and there his experience did not agree with that of the author, that there was a profit to be made out of the arrangement. He might retort by saying that if it required this costly storage, there would be a saving on the capital expenditure; but the difference would have to be expended on generators, to meet the maximum demand.

The PRESIDENT said many years ago they worked under the twelve-hour system, but for the last 25 years they had been on the eight-hour, and under it the gas stoker certainly did get more physical rest. They shifted on the Sabbath, and the two gangs came on for a few hours, and then went off; so that practically they carried out a portion of the principle enunciated in the paper. The men were paid for the time they were off; and this was the difficulty he felt in going in for the system more completely. He was afraid that the men having once enjoyed the privilege of receiving money for doing nothing, he should have some trouble to persuade them to stay off for twelve hours and not be paid for it. This, however, was a matter to be tried.

Mr. SHADBOLT, in reply, said the members would no doubt appreciate the delicacy of his position, in coming forward with a subject which, as Mr. West had said, was dealt with a good many years ago, and which those who were interested in it then thought was settled for all time, as far as the gas world was concerned. It was really astonishing, in going through the replies he had received, to see the divergence of opinion which still existed. Some gentlemen of lengthy experience seemed to imagine that because they had adopted Sunday stops for many years, everybody else must of necessity follow. He thought the replies might be taken, in the case of those who stopped, as fairly representative in number, as well as in character, because those gentlemen, generally speaking, who were in favour of the cessation of carbonization on Sunday, and practised it, had been most ready to reply. He did not think there were many who really stopped who had not replied; but this was purely a matter of speculation. He must congratulate himself on one thing—that, in all probability, the replies received and the information they contained were the most full and representative that had hitherto been obtained on this subject. They furnished evidence of practically the easing off of Sunday labour with regard to half the stokers in the United Kingdom; and he believed that whenever the subject was taken up again—say, in the next generation or two—whoever had the temerity to do so would be able to say that the other 50 per cent. were resting also. It was only natural that there should be divergence of opinion on this subject as well as everything else, because the conditions were so various and changeful. He only wished that there had been more present who were opposed to the Sunday stop, to give their reasons. There were some difficulties of which one gentleman had no knowledge, but which another laboured under; and it was only when they understood the nature of these difficulties that they could be appreciated. There would always, so long as gas was made by the present method, be some places where it would be found utterly impossible to reduce Sunday labour to any material extent; and the circumstances and local conditions must rule in every particular case. Mr. Carter had referred very kindly to himself and his paper, but said he did not agree with him on the question of profit. Now, those who happened to be present at the commencement of the paper would know that he did not claim any profit; but he endeavoured to show that there was no actual loss when once the thing was thoroughly established. While on this question, he might dispose of Mr. Porter, and pit his three years' experience against that gentleman's six months'. The loss was more than counterbalanced by the advantages obtained. Mr. Carr thought the men were against Sunday stops in some instances, and preferred to work and be paid for it; but this was not an argument against the principle. If it proved anything at all, it proved the demoralizing effect of the old system. With regard to the eight-hour shift, Mr. Carr said

the men worked 50 per cent. more in two Sundays out of three, and then had a free Sunday and were paid for it. Of course they were; and they ought to be. But this did not affect the question of Sunday rest. If a man was working, and did 50 per cent. more work on two-thirds of the Sundays than he did in the ordinary way, so that he might have a rest on the third Sunday, the total amount of labour done over the three Sundays was exactly the same as if he worked the ordinary eight-hour shift on each occasion. He had not only earned more money, but he had earned rest as well, because really on two of the Sundays he had been labouring much harder than on any ordinary occasion. It was rather degrading to an industry like theirs to think that it should be necessary for a man to work two Sundays out of three the hardest in his life, in order that he might have some slight rest on the third Sunday. Mr. Jones's remarks were somewhat in the same strain; but really it was only those gentlemen who had not had any lengthy experience of stops who talked in this way. He had to thank Mr. Harris and also Mr. Ellery for their remarks. He thought in one of his tables he showed the case of a man who, having had about two years' experience of Sunday stops, reverted to the old practice. The reason assigned in that case was that the eight-hour shift and extra pay for Sunday work, both of which were factors, operated against the introduction of the stops. He was glad Mr. Townsend was able to stop his inclines as well as his horizontals. He thought the President's experience was not unique. This pay for work not done, and extra rate of pay for work that had to be done, were undoubtedly two great factors against the spread of the movement. But one thing they could depend upon—that, whether they liked it or not, public opinion was against working through. The time had arrived when they must perforce bow to public opinion in this matter, as they had to do in other things; and the time was not far distant when the cessation of carbonization on the Sabbath would be the rule, and working through the exception.

IS THE GAS CAPITAL IN ENGLAND AND WALES EXCESSIVE?

By C. E. Jones, Assoc.M.Inst.C.E., of London.

Power of Capital.

Capital, rightly and honestly applied, is an instrument for good. It is the archimedean lever which lifts the commercial world and provides employment for the human race. Without its aid the engineer would be powerless to "direct the great sources of power in Nature for the use and convenience of man." Its achievements are prodigious and infinitive. It bridges the estuary, tunnels the sea, pierces the mountain, associates continents, connects the old and the new world, transmits silent messages beneath the waves, and flashes through the atmosphere Marconic tidings of moment, of joy, or sorrow. From the solid earth it extracts mineral wealth of immeasurable value, and from the mighty deep its animate and dead treasures. It arrests the flow of rivers and forms new ones, dams the stream and conserves the waters, irrigates the land—making even deserts fertile—constructs the aqueduct, lays the conduit, supplies the wants and quenches the thirst of millions of men and animals. It transports whole armies with rapid ease, and hurries merchandize from country to country, market to market, abridging distance, defying space, and redeeming time. From the coal mine, it lifts the sunbeams entombed ages ago, reproducing their iridescence for the purpose of dispelling darkness, guiding the mariner, illuminating our homes, cooking our viands, driving machinery, or carrying us on lofty aerial journeys. Its influence knows no bounds, nor has its potentiality any limits. We have ceased to wonder at the magnitude of its operations, or to marvel at its newest development. A little time devoted to this potent agency will not be ill-spent, nor the consideration of its present bearing on our industry, its past influence and future prospects unworthy of discussion in the parliament of light and leading.

Capital and Trading.

Capital advantageously raised and wisely expended is the spirit and essence of trade. It then multiplies, becomes a source of profit to its owners, beneficial to the community, and promotes the fellowship of man and the brotherhood of nations. How to profitably expend capital is not so easy a matter as may be supposed by the inexperienced.

Capital Stocktaking.

Taking stock of capital is as necessary a proceeding as taking stock of stores, and should receive the same careful attention. An audit or stocktaking time enables us to compare results, remove doubts, correct past mistakes, establish confidence, renounce unsound policies, abandon obsolete methods, conceive new ideas, initiate new enterprises, and devote our energies to channels more compatible with the industrial needs of the times, improved illumination, the exigencies of modern domestic economy, or the fashionable necessities or fancies of society.

Ratio to Gas Production.

Viewed in the light of its just relative proportion to production—the work to be performed per unit subscribed—capital becomes invested with attributes of vital importance to the economic existence of the industry. This is the *crux* of the matter. Inflated, lavishly expended, it is beset by difficulties and trials leading to disappointment, disaster, and ultimate ruin. Judiciously expended and efficiently managed, it grows, supporting and augmenting individual and national prosperity. The capital audit also shows at a glance the distance we have travelled and the pace of the machine, whether the motion has been progressive or retrograde, too fast or too slow, and whether it needs lubrication or the application of brake power. It likewise furnishes us with a means of gauging collective directorial capacity. It irreverently questions that sacred theme "The Policy of the Board." It measures up engineering works, the prudence and skill displayed, condemns extravagance, commends economy, and dares to be just to managerical efficiency or otherwise in administration. Praise is lavishly bestowed on the management of works with a low capital and an expanding district paying full dividends and selling gas cheaply, and withheld from another labouring under adverse conditions and actually requiring more skill to successfully manage it. Our capital audit reveals the true condition and secret of success in these extreme cases, as well as throwing he searchlight on others.

Object of the Memoir.—Capital Defined.

The primary object of this memoir is briefly to take stock of the capital of gas companies as a whole—endeavour to ascertain if it be too high, and, if so, indicate, if possible, means for its reduction. The capital here meant is the whole amount of money employed, however raised, for carrying on the business, and entitled to dividend or to bear interest.

Capital and Tangible Value.

This capital as defined should be represented by land and works and property intrinsically equivalent to monetary value as shown in the balance-sheet of the undertaking; after allowing 10 per cent. as floating capital to carry on the current financial operations of the business. Equitable capital should not be above or below the value of the works executed or immediately contemplated. What is a just and equitable capital for any and every works is difficult to determine without a knowledge of the history of the company or its special circumstances.

A Many-Sided Question.

The subject is many-sided, far-reaching, and complicated withal; and at the outset the author unreservedly—in common with those more able men who have treated the subject in the past—acknowledges its uninviting aspect. Full of anomalies, permeated by incongruities, bristling with difficulties, it presents a problem altogether intricate and embarrassing. Furthermore, it is surrounded and shielded by statutory enactments, parliamentary precedents, restrictive laws, vested interests, official interference, and fanciful and shadowy rights that render the establishment of a universal standard practically impossible.

Uniformity in gas capital does not obtain, never did obtain, and is probably unattainable. Experience in earlier days had to be bought, and oftentimes was dearly paid for. Such diverse conditions obtained in past times and in different towns, that few cases were alike. Variation in practice is now so great that the aid of the Imperial Parliament is generally sought to unravel its intricacies, sweep away flimsy claims and sophistical propositions, and do

substantial justice between conflicting interests—the contending parties represented by the consumers on the one hand, and those who find the capital, on the other. After years of experience, even Parliament has failed to discover any mode for the general formulation or unification of gas capital applicable to all cases. Each application is considered and decided on its merits. Where Parliament has failed, who can hope to succeed? It would be presumptuous to expect it; and no one more than the author is conscious of the shortcomings and incompleteness of this memoir. But that should not preclude us from attempting to add our mite towards the elucidation of the problem which appears *primâ facie* simple enough, but on closer acquaintance is shown to be complex and ramified with difficulty.

Reasons for Confining the Inquiry to Private Enterprise.

A desire to condense the subject matter within the space usually allotted to a paper, and a wish to avoid overcrowding such circumscribed space, induced the author to confine attention to the statutory gas companies in England and Wales, other than those of local authorities; leaving the latter to be dealt with later by abler hands whose efforts may embrace a wider field geographically than is here adopted. No discourtesy is suggested to these large works and important interests by their omission from the memoir, which lays no claim to completeness, although it may be stated that all undertakings belonging to companies have been examined, and nearly 400 of them figure in the investigation, the results of which are embodied in the paper. Thus nearly three-fourths of the total number of gas undertakings in the United Kingdom come within the category.

Uniformity a Chimera.

As before mentioned, there is such a general absence of uniformity in the ratio of capital employed per ton of coals carbonized or per 1000 cubic feet sold, and such a variety of circumstances influence, if not actually governing, the cases, that it would probably be an unjust act to impose on works a hard-and-fast line or a limit beyond which it would be perilous to go. Elasticity is desirable, and has parliamentary sanction. Until the conditions are identical, absolute agreement is a chimera, and unattainable in this or any other commercial country. Nevertheless something is gained when the disparity is reduced—not by levelling up, however, but by the reverse operation.

A study of the question shows clearly that, notwithstanding disturbing causes, many undertakings are over-capitalized; and few earnest or persistent efforts are being made to reduce or write off unproductive capital, and thus bring the structural value in accord with the valuation of the property as it appears in the books pertaining to the undertaking. This should be done in the permanent interests of the companies themselves; and how to accomplish the task without doing an injustice to existing proprietary interests, and those of the public, it is hopefully expected that the discussion to follow the reading of the paper will indicate.

Over-Capitalization.

It is but just, however, to remark that over capitalization is by no means confined to gas companies. With railways, electric traction, ocean traffic, docks, trusts, and other industrial concerns, the cry is still the same. It is a stupendous evil, a cancerous disease, calculated to crush the life out of all joint-stock enterprises if persisted in. In no industry perhaps does it attract so much public attention, or evoke such adverse criticism, as that with which we are specially identified. This is partly or wholly due to the inaction or want of tact on the part of the companies themselves. Public opinion is often disregarded, agitation treated with contempt, and unjust accusations allowed to go by default—no attempt being made to remove false impressions; the board dwelling meanwhile in the blissful consciousness of probity, and happy in the security afforded by Acts of Parliaments and statutory dividends. The time has arrived, however, when this apathetic attitude should be changed for one recognizing the virtues of conciliatory explanation, and the identity of interests of the consumer and producer of coal gas. The antagonism of governing bodies to over-capitalized gas companies is a substantial grievance, especially where the auction clauses and the sliding-scale for regulating dividends are not compulsory.

Causes of High Capital.

Some of the causes of abnormal capital may be catalogued as follows:—

(*a*)—Preliminary expenses.
(*b*)—Parliamentary opposition.
(*c*)—Raising money at high interest.
(*d*)—Price of land, and bad selection of site.
(*e*)—Lack of skill in design of works.
(*f*)—Payment of interest out of capital during construction of works.
(*g*)—Erection of works during periods of inflated prices.
(*h*)—Payment of directors' fees on the basis of a percentage on the capital paid up.
(*i*)—Character of the supply.
(*j*)—Confusion of ideas as to charges to capital or revenue account.
(*k*)—Refusal of legislative sanction for the creation of redemption funds.

These points may be considered more in detail in the order named.

a.—Preliminary expenses are inevitable, and where promotion money is employed, often amount to a considerable sum. That these expenses should constitute a charge on the undertaking in perpetuity, is neither desirable nor justified. The sooner they are wiped out the better for all parties concerned.

b.—The costs of obtaining original or further parliamentary powers is also usually capitalized, and have no structural asset. Parliamentary opposition is responsible for much unproductive capital, especially in contests where a persistent combative spirit pervades the authority whose local rates provide unlimited funds. Much expense might be avoided were opponents more reasonable in their demands, and promoters more conciliatory towards consumers' interests. The companies being generally by no means insignificant ratepayers, have the privilege of providing the sinews of war for both attack and defence; while the consumer has the pleasure of paying interest perpetually—in the price of gas—on the cost of obtaining the Act. It would appear that, in order to discourage fruitless expense in opposing Bills, Parliament mulcts the district in interest on the sum expended. On both sides, it is admitted such expenditure is legitimate. Efforts should be made to eliminate such charges from the capital account by debiting the same to a suspense account or to revenue direct. By the latter procedure, the consumer who caused the expenditure would then pay the bill, and not hand on the account to succeeding generations. This in some cases has been done; but as a rule the amount is capitalized, and still figures in the books as an unproductive item, with nothing to show for it, unless local feeling, victory or defeat, may be taken as an equivalent asset.

c.—Original capital still receives preferential treatment in being allowed maximum dividend—usually 10 per cent.—while new and additional capital is limited to 7 and 5 per cent. or less. It was not an unknown practice for all money to be raised at the higher rate of interest; the shares being allotted to the then existing shareholders, who often disposed of their right by renouncement in favour of others for a monetary consideration. To extirpate this abuse, auction clauses and sliding scales were invented. Inducement in theory at all events no longer exists for unduly augmenting capital; the auction clauses having swept away ancient privileges, and given the public access to the share list; while any premium realized by the sale of shares bears no dividend or interest whatsoever.

The principle of the auction clauses is a sound one; but the sliding-scale is not viewed with the same favour by many. In the author's opinion, it is a form of bribery destined to play havoc with gas companies. If anything is calculated to induce a manager to starve his works and serve current exigencies, it is this sliding-scale. Already, as was foreseen and foretold by some (the author among others), it has effected an alteration in the "initial price," and when the scale operates against the consumer, the dormant signs of discontent break out afresh. Judging from experience, local authorities have little or no faith in sliding-scales or auction clauses, and are as keenly combative as ever on the question of additional capital; parliamentary opposition being often centred on this point alone, generally with results favourable to the opposing bodies, either in a reduction in the amount asked for or the rate of

interest sought. In this connection, it is surprising that more use should not be made of borrowing powers. Safe security, such as gas property offers, can always command cheap money. The statutory powers in this respect may be safely extended; but it must be acknowledged that many companies do not now exercise sufficiently the borrowing powers bestowed by the Legislature upon them. It is the reverse of good finance to raise money at 5 per cent. when it can be got at 3 per cent.

d.—The cost of land is a very elastic and uncertain item. Land which is almost unsaleable, immediately it is required for works is suddenly endowed with a value perfectly astonishing, and a fabulous rate demanded for what could under ordinary circumstances be bought in rural districts at £50 to £100 per acre. The subsoil may be unfavourable, the site none of the best, and still the price asked may be prohibitive, or more than it is worth. In these instances, it is sometimes advisable to go further afield, and incur the expense of a trunk main, rather than pay fancy prices for land required. Contiguity to rail or water carriage accommodation is almost a *sine quâ non*.

e.—Manufacturing works should be laid out with a view to future extension on a system of units easily multiplied as required; proportionate construction should be studied, so that no portion of the plant is out of symetrical harmony with the whole. Excessive provision is to be deprecated; and while taste should be displayed, elaborate ornamentation is to be eschewed, although it must be admitted that gas-works do not often err in this respect. To over-estimate prospective requirements and hastily or unduly provide for them, is to swell the capital account and necessitate the maintenance of a high selling price for the staple product.

f.—Payment of interest out of capital may be justified in certain cases; but as its tendency is towards inflation of capital, it is to be deprecated, and the temptation to call up more capital than is immediately required always resisted. "Easy come easy go" is a proverb that is still applied to the unthrifty.

g.—Works not urgently needed should not be executed during periods of inflated prices of material and labour. The avoidance of this rule cannot always be ensured; but directors of companies, as well as other spending bodies, have much to answer for in this respect—contracts being made at times and seasons unfavourable to economic construction. Neither is premature expenditure of capital altogether unknown.

h.—Where the practice of the payment of directors by a percentage on the capital subscribed obtains, there is a suspected tendency to increase the capital expenditure in a manner not fully warranted; unpleasant remarks are made and public confidence withheld. The system is liable to abuse, and therefore mischievous, and not worthy of being perpetuated. If the directorate is to be remunerated according to results, then so much per million cubic feet sold would be a better way of arriving at the sum to be voted. It is within the cognizance of the author that the remuneration of a board of directors increased 327 per cent. in ten years, while the gross revenue during the decade increased by only 63 per cent. There were no circumstances justifying this enormous increase; but, as the generous proprietors voted the money themselves, it was perfectly legal.

i.—An important factor in connection with the question is the character of the supply, if largely intermittent or fairly constant, the area compact or widely scattered, the consumers residential and numerous with a large consumption per mile of main, or the district abounding in mills and factories, which only burn gas for a few minutes or hours a day and only a few months of the year. In some of the cotton districts in Lancashire, 15 per cent. of the day's consumption is sometimes delivered in an hour; and for two-thirds of the year 90 per cent. of the plant is lying idle, or but sparsely employed. Yet it is essential that the power of the works must be maintained up to the maximum in order to cope with extraordinary demands and satisfy all requirements. It follows, therefore, that much storage is required, and the delivering capacity of the mains must be ample, entailing capital expenditure largely in excess of what is considered reasonable to be provided. Contrast this with the more equable requirements of a fashionable seaside watering place. During the brighter portions of the year, mills require no artificial light; and the gas manager's lot, like the policeman's, is not a happy one. While the watering-place has a demand for gas for cooking, and for entertainments, hotels, lodging houses, and so on, which the unhappy manager alluded to would hail with delight if they would only come his way.

j.—Thanks to the discussions in the Institute and kindred bodies, clearer ideas of what expenditure should be debited to capital and what to revenue prevail than formerly. A concensus of opinion agrees in charging all renewals to revenue, and all new works, other than renewals, to capital. This is unquestionably the true principle to be borne in mind, although it should be remembered that in former times many works were extended, if not reconstructed, entirely out of revenue, to their manifest advantage in after years. To attempt to do this now, would certainly ensure an appearance in the Court of Quarter Sessions to show cause why the price of gas should not be reduced, followed in all probability by the appointment of an accountant or other competent person to conduct an inquiry into the pecuniary affairs of the undertakers, which the latter must assist and facilitate by the production of all books, bills, receipts, vouchers, &c., under a penalty for neglect of £100, and £10 a day for refusal so long as such wilful neglect shall continue. (See Gas-Works Clauses Act, 1847; sections 35, 36, 37, and 38.) These are severe conditions, and cannot be accepted as satisfactory or just to the gas industry, especially to undertakings heavily burdened by capital and anxious to reduce it. No other branch of trading enterprise is shackled by bondage so harsh and unyielding as this; and it says much for the companies that they have carried the yoke patiently and obeyed the law.

k.—For some unexplainable reason, Parliament hitherto has withheld permission for companies, except in certain defined cases (such as mortgages and leasehold lands, &c.), to reduce their capital by means of a depreciation, contingency, sinking, or redemption fund, although insisting on such procedure in the case of local authorities owning gas-works. Why this distinction should prevail is not apparent to ordinary minds, since the principle is equally material to all gas undertakings, irrespective of ownership. "What is sauce for the goose should be sauce for the gander;" but in gaseous cases the sauce is served to one of the parties only. At all events, unless there is a provision in the Special Act giving power to do so, it is illegal to create such a fund or to redeem capital by such means. A reserve fund may be started, or a large balance carried over, but it is questionable if it is applicable to any other purpose than that of equalizing dividends or meeting any extraordinary claim or demand.

No gas company can have a reserve and a contingency fund (see the Gas-Works Clauses Act, 1847, section 31, and the Companies Clauses Consolidated Act, 1845, section 122). The power given by the Act of 1845 was taken away, or rendered nugatory, by the Act of 1847. Whether this was intentional on the part of the draughtsman or not, is a mootable point; but there can be no doubt at all as to the injurious effect it has produced on the gas industry, by perpetuating created capital, prohibiting its reduction, and complicating the whole question of divisible profits. Most companies take advantage of the power to form a reserve fund for meeting deficiencies in dividends; but a certificate of justices of the peace is necessary to enable any part of the fund to be applied to meet any loss due to accident, contingency, or extraordinary claim outside ordinary working expenses. (See the Gas-Works Clauses Act, 1847, section 32.) Thus it is clear that the consumer is burdened by this policy, and not the companies only, who defer as long as possible the operation of the statute provided for ensuring a reduced price of gas when the reserve fund is full. This takes place but seldom, and in most companies never; and a large balance carried over can perform the same functions as a reserve fund.

Assuming that the reserve fund amounts to 10 per cent. of the nominal capital and full dividends to be declared, all surplus profits become the property of the consumer, and must be handed over to him by means of a reduced price for gas. Hence the application of surplus profits to capital purposes is frustrated; and if objected to by two consumers only, the arm of the law is invoked, and the aim of the engineer to reduce his redundant capital is easily defeated. Once capital always capital appears to be a legal axiom, somewhat out of date and agreement with the spirit of the times. It is but natural that the present generation of consumers should object to be penalized for the sake of posterity—any generation would; and so it comes about that the price of gas is maintained at a figure necessary to produce a sufficient annual sum to pay the dividends allowed

by law. The consumer, therefore, pays after all. This policy is not satisfactory to either party, and should either be mended or ended. It is in restraint of trade, checks its natural growth, and is effectual in preventing collateral and direct expansion; it cramps industry, delays improvement, and withholds the impetus of fulness of motion given to commercial development by cheaper production and a lower selling price of our staple commodity. Capital and price seem inseparable; and if the former were reduced, the latter must follow. Such a process is even now going on silently and slowly—too slowly; and the causes operating in this direction are now to be considered.

Capital is Being Reduced.

1.—*The Auction Clauses.* Foremost in this operation stand the auction clauses, which have already produced over £4,250,000 sterling as premiums applied to capital purposes, but bearing no dividend although earning it. Its usefulness as a scheme to remedy the abuses of the old system of issuing new shares to the favoured few is apparent in the immense sum realized by throwing open to the public the share list. It is, of course, applicable chiefly to growing and prosperous undertakings, whose shares are at a good premium in the open market. The *modus operandi*, however, is slow, and confined to those companies whose shares are most in favour with investors. Thus the poorer and overweighted undertakings derive no benefit whatever from this excellent device, which is the more to be regretted, as the over-capitalized works stand in more need of assistance than their more fortunate contemporaries.

2.—*Prepayment Meters.* Another cause operating in this direction is the extended use of the prepayment meter, which not only increases the consumption of gas and abolishes the credit system, but provides a large proportion of floating capital necessary to conduct the business. Like the premiums referred to above, this floating capital bears no charge, though it may earn bank interest on "current account." Frequent collection of coin from these meters removes temptation from the fraudulent, disappoints the would-be thief, and furnishes ready cash as aforesaid.

3.—*Guide Framing.* The invention of columnless gasholders and the principle of guiding vessels of this description by wire ropes, enable the engineer to erect these structures at much less cost per 1000 cubic feet capacity than the ordinary type of holder, with its massive cast-iron or elaborate wrought-iron lattice guide-framing—three-fourths to two-thirds of the cost of guides being saved.

4.—*Water-Gas Plant.* This plant can be erected in such a compact form and moderate compass compared to the space required for ordinary gas retort-houses, and must therefore be accounted as a means of reducing capital, or retarding its too rapid augmentation. The ease with which large volumes of gas can be evolved in times of emergency is a strong recommendation in favour of this description of plant.

5.—*Stoking and Conveying Machinery.* This must not be omitted; the saving effected by its use in large works being considerable. It may be that further experience of the inclined retort system will add yet another factor to those already operating to reduce capital; but at present it is not sufficiently pronounced.

6.—*Mains and Services and Meters.* Thirty per cent. of the capital is usually expended in the laying of mains and services and providing and fixing meters. The multiplication of street-mains has been a prolific waste of capital; and a considerable saving can be effected by working higher initial pressure in lieu of enlarging the size or multiplying the number of mains. Low pressure means large mains and services, and more capital, with its inevitable charge on revenue. High pressures obviate, within certain limits, the necessity of larger mains and consequent waste of capital. The time is at hand for making a new departure. Notwithstanding the objections of the low-pressure school, there is no insurmountable difficulty in the manipulation of gaseous bodies under pressure than is to be found in the case of air, steam, or water. Given sound apparatus, there is none. Mains and services not absolutely tight indicate bad materials or inferior workmanship, or both. Pipes and fittings are now made and tested to any pressure required, and can be jointed together without leakage. The working load of gas distribution, compared to compressed air, water, or steam, is infinitesimal, and can be safely increased.

The times have changed since wooden and earthen ware pipes were in use as mains, and gun-barrels for services. Flimsy iron tubing and gossamer fittings should no longer be tolerated. Bad workmanship should be improved off the face of the earth, and no more known. It has been the author's practice to use the best material obtainable in cast-iron pipes, coated with Dr. Angus Smith's composition, subjected to hydraulic tests, and the heaviest steam tubing for services, the unaccounted-for gas being as low as 4 per cent. He is persuaded that the abolition of the low-pressure doctrine, as at present known and practised, is imminent and in time will be obsolete. A demand has arisen for gas at high pressure for engine, power, cooking, metallurgical, analytical, intensified gas lighting, and fuel purposes, which must be met if coal gas is to extend its sphere of usefulness, widen the domain of its industrial activity by anticipating our social, commercial, and national requirements, and is to maintain its onward march. Imagine the saving in capital that might be effected on mains alone; and the gain to the householder by using smaller internal pipes would be enormous. Compare the neat appearance of the dainty insulated electric wire with the huge pipes required for delivering gas to a moderate sized house, a palatial hotel, a cotton mill, or factory. It is patent which has the advantage.

As a means then of reducing capital, high-pressure gas is one of the most important; and the engineer of the future will employ and take advantage of this reserve of power to the full extent. It is not generally known that under high pressure the deposition of naphthalene in pipes is rendered more difficult, if it occurs at all under such conditions. This substance, so interesting to the chemist investigating substitution-products, is to the gas manager an unmitigated nuisance, causing obstruction in the distributory apparatus, and preventing the flow of gas. What change in its composition takes place is not known; but bearing in mind the hypothetical doctrine of catalysis, or the accepted doctrine of chemical substitution, it appears to undergo some physical or chemical modification under pressure, enabling the compound to preserve its gaseous form, even to the point of combustion. Such decrepid arguments advanced in favour of low pressures, especially in the day time—such as exosmose, disarrangement of consumers' meters, deposition of light-giving hydrocarbons, leakage, and the like—were used to cover defects in apparatus or mode of working, and may still be speciously advanced. But the works that cannot safely work higher pressures than those defined by statute—viz., 6-10ths to 10-10ths or thereabouts of water gauge—for fear of losing gas by leakage, should forthwith be remodelled. They are worn out and unfit for duty. It is to be hoped that few or none of these crazy old undertakings are left.

Sales per Mile of Main.

Consumption per mile of main is so intimately associated with relative capital expenditure, that it is highly desirable to use every legitimate effort to increase the sale of gas in the day-time, and reduce the disparity between day and night consumption. This is a field worthy of assiduous cultivation. Services for any reasonable distance should be laid, and meters fixed, free of charge. Cookers and burners should be maintained and renewed at cost price, and not abandoned to ill-usage resulting from want of knowledge on the part of inexperienced users. Remember that custom is obtained by oil and electricity venders by canvassing, by gratuitous advice, and by free wiring. Cheaper mantles are to be welcomed, and may be made and sold by gas companies themselves under licence. It is not sufficient, however, to simply sell the article; the trouble of maintenance should be undertaken by the purveyors of coal gas, and not left entirely to the busy or indolent consumer. These are important points worthy of practical consideration if the sale of gas per mile of main is to be increased, and the dangerous competition of oil successfully combated. There is no reason to doubt the ability of gas managers, with the sanction and co-operation of the directorate, to accomplish this.

Arguments against Reduction of Capital.

Without controversy, existence would be excessively dull, and life exceedingly monotonous; and there is always something to be said on the other side, and reasons can be advanced for keeping up capital on the ground that a low capitalized concern is a temptation to intending or would-be purchasers, if the false doctrine be admitted as true that the worth of a thing is what it will fetch. Value is not always represented by the price asked or agreed upon; and, strange

as it may seem, a low capitalized and well-managed undertaking realizes no more, or not so much, as an indifferently conducted or high capitalized one. Indeed, it is sometimes contended now-a-days that a badly equipped and worse managed works affords more scope for economic development, and is consequently of more value than one that does not lend itself so readily to improvement, or permit the easy application of the "glorious principles of retrenchment and reform." In plain Saxon, old goods are worth more than new. If the articles are ancient works of art or old wine, it might possibly apply; but the ingenious theory, though admirable from the seller's point of view, is hardly likely to be accepted by the buyer, who cries "it is naught, it is naught," after the manner of bargain hunters of long ago. Still, the fact remains that by estimating the value of a gas-works by so many years' purchase (usually about 25) of maintainable dividends, instead of on the real value of the estate, injustice is inflicted on those who have kept down capital to its lowest point in order to sell gas cheaply, and establish the undertaking on a sound commercial basis; and no encouragement is offered or awarded for due care and management.

An aggregate of consumers having had the benefit of cheap gas, now acquire the property at a low price also. Thus the company is dually penalized for good management, and compelled to sell on the basis of profits and not the genuine or intrinsic value. This aspect of the case has been discussed by the Institute before; and the following hypothetical case was ably stated by one of the giants of the profession in the hearing of the writer twenty-four years ago. Its appropriateness will be seen at a glance: "Company No. 1 sell 100 million cubic feet a year, and have for this purpose the moderate capital of (say) £50,000. They divide among shareholders, at 10 per cent., £5000 a year; and the price they would receive from a purchasing authority would be, at twenty-five years' purchase, £125,000. Company No. 2 also sell 100 millions; but have the extravagant capital of £100,000, or nearly £10 per ton of coal. The dividend amounts to £10,000 a year at 10 per cent.; they would, therefore, at 25 years purchase, receive £250,000, or double the amount of No. 1."

Again, Parliament sanctioned the capital expended, and forced restrictive conditions on the companies, compelling them to supply gas, limiting dividends, prescribing the purity and illuminating power, and manner of keeping accounts, and furnishing tabulated returns, refused them facilities to reduce capital out of profits, and placed them at the mercy of any two consumers. The directorate, viewing themselves trustees for the shareholders, decline to meddle with such a sacred thing as capital; it being *ultra vires* and illegal. They asked not for this complex legislation; but they acquiesced therein, and kept the law, their *quid pro quo* being security from competition—not, be it here observed, in light, but in light obtained from coal gas. Any real security the companies ever had has disappeared, and effective competition in light is again rampant, and encouraged by legislation, and even subsidized indirectly by local rates—nay, even local authorities are in the field themselves, both as opposing bodies in Parliament, and as competitors in light elsewhere. Those who hold these views are within their rights; but they may cry out aloud, and no man regardeth—"the old order changeth, giving place to the new." Such directors will probably experience a rude awakening when seeking further parliamentary powers.

Proportionate Capital.

What then is a sufficiency of capital per ton of coal carbonized or per million cubic feet sold? It has been contended that it should not exceed £5 per ton including everything, even floating capital. This liberal standard might apply to modern works unencumbered by causes and effects, some of which have been all too briefly alluded to in this memoir. But it appears to the author to be too drastic for general adoption. After a diligent arithmetical investigation of the capital accounts of nearly 400 gas companies, the author has arrived at the conclusion that no arbitrary standard is possible. In compiling the following table, therefore, he has grouped the works according to the quantity of coal carbonized; and in order to avoid wounding the tender susceptibilities of managers struggling with difficulties, or inflicting a shadow of injustice on companies over-capitalized through no fault of their own, no names are given or places mentioned. Any engineer, however, interested can ascertain, by consulting the table, whether his working is above or below the average of the group to which his works belong.

The classification is as follows; every care being taken to eliminate error, ensure accuracy, and permit of comparison. The first column states the number of tons of coal in the aggregate used by each group; the second, the capital employed; No. 3, the gas sold in thousands; No. 4, the capital employed per ton (calculated to the nearest penny); No. 5, the capital employed per 1000 cubic feet sold. The number of miles of main in each group is given in No. 6; gas sold per mile, in thousands, in No. 7; the number of consumers, in No. 8; and the gas sold, in thousands per consumer, in No. 9.

The first group (A) comprises all works using not more than 250 tons each per annum, B not exceeding 500 tons a year, C not more than 1000 tons a year, D not more than 2000 tons, E similarly 3000, F 4000, G 5000, H 6000, I 7000, J 8000, K 9000, and L 10,000 tons per annum, advancing by 1000 tons per annum. The larger works, being less numerous, are grouped thus: M, over 10,000 and not exceeding 12,000 tons each works; N, over 12,000 and not exceeding 15,000 tons; O, over 15,000 and not exceeding 20,000 tons; P, 20,000 to 30,000 tons; Q, 30,000 but not exceeding 60,000 tons; R, 60,000 but not exceeding 100,000 tons; and S, all works of 100,000 tons and upwards per annum. It will be observed that the smallest works—group A—employ some $3\frac{1}{2}$ times more than group S, comprised of the largest works, not only in this country, but the world. The same remark applies to companies other than the smallest. There is a somewhat irregular graduation from A to S, from maximum to minimum; but in each group the disparity is very marked—some works employing six times as much capital as suffices for others in the same group. In no case in the table is the capital employed per ton as low as £5; but there are many individual works below this figure even among the smaller concerns. These extraordinary divergencies may be capable of explanation, as pointed out earlier. But ordinary minds, untrained to recognize such niceties of logical discrimination, will probably conclude, with tolerable accuracy, that some of the

Groups.	Coal Carbonized (Tons)	Capital Employed. (Pounds Sterling).	Gas Sold per Annum. (Cubic Feet).	Capital Employed per ton Carbonized.	Capital Employed per 1000 Ft. Sold.	Miles of Main.	Gas Sold per Mile of Main (Thousands).	Number of Consumers.	Gas Sold per Consumer (Thousands).	Groups.
				£ s. d.	s. d.					
A	1,300	22,427	11,230,000	17 5 0	39 0·06	14·50	774	563	20	A
B	6,138	75,644	40,662,900	12 6 6	37 2·47	55·00	739	1,818	22	B
C	21,074	257,769	165,028,483	12 4 8	31 2·87	157·00	1051	6,580	25	C
D	101,962	863,793	838,560,110	8 9 5	20 7·22	564·50	1486	26,540	30	D
E	100,565	674,203	867,829,562	6 14 1	15 6·45	437·50	1983	27,220	31	E
F	124,777	921,590	1,040,730,746	7 7 9	17 8·52	507·50	2050	32,197	35	F
G	135,209	939,652	1,150,124,352	6 19 0	16 4·08	646·75	2474	33,191	34	G
H	120,871	883,249	1,136,913,909	7 6 2	15 6·45	472·75	2404	36,673	31	H
I	96,841	808,506	903,426,065	8 7 0	17 10·77	380·00	2377	29,704	30	I
J	120,611	848,797	1,132,759,657	7 0 9	14 11·83	344 50	3288	33,876	33	J
K	77,655	462,326	726,200,380	5 19 1	12 8·79	247·00	2940	20,645	35	K
L	84,308	635,206	805,314,200	7 10 8	15 9·30	264·75	3004	21,039	38	L
M	132,520	872,378	1,216,432,540	6 11 8	14 4·11	367·75	3307	30,294	40	M
N	175,594	1,093,755	1,625,997,876	6 4 7	13 5·43	430·50	3777	53,596	30	N
O	209,779	1,430,428	2,258,190,841	6 14 4	12 8 02	565·75	3991	56,336	40	O
P	594,673	3,241,227	5,700,103,638	5 9 0	11 4·47	1221·00	4668	142,625	39	P
Q	729,897	4,280,057	8,112,462,859	5 17 3	10 6·62	1700·25	4771	202,514	40	Q
R	550,994	2,990,323	5,523,814,200	5 8 7	10 9·92	866 50	6374	113,597	48	R
S	4,991,085	25,504,856	46,972,351,428	5 2 1	10 10·31	5770·50	8122	855,875	54	S
Totals.	8,375,853	46,806,186	80,228,133,746	—	—	—	—	—	—	—

aged works have been improved, extended, and almost entirely reconstructed out of revenue; and others, less fortunate, have been constrained to charge such outlay to capital account. On the other hand, there are modern works carbonizing 10,000 tons of coal and upwards per annum, in compact and densely populated districts, whose capital expenditures seem unjustifiably large—in some cases three times as much as works in the same group and in the same county.

Disparity may be Reduced.

By intelligent and persistent financial efforts, it is quite possible to reduce these enormous differences. No more important question can engage the attention of directorial acumen than this. The future prosperity of the gas industry largely reposes on the minimum amount of capital required to conduct it. This fact is emphasized by the economic conflict rival lights are waging against the industry. Heavily capitalized undertakings are no longer secure. To use a sporting phrase, they are "handicapped to lose"—the weight they carry places the cargo in jeopardy. Surely there are many boards of directors capable of rising to the occasion and grappling successfully with this financial problem. With excessive capital, the idea of cheap gas is illusory; and without cheap gas the progressive development of the industry is arrested, stagnation ensues, and unless we are alert, extinction follows. Good administration will obviate this; the time for apathy has passed by. "We must take the current when it serves, or lose our ventures." The *personnel* of the industry merit all the praise they receive, and more; but so long as undertakings, gas or otherwise, continue to be governed by amateurish directors of the-rest-and-be-thankful type, with no technical qualification for the office, the true position destined for what is a national industry using native mineral wealth and conferring untold benefit on the trading, industrial, commercial, and social classes, will be postponed or but tardily reached. During this transitional period, men with penetration and administrative ability are needed.

General Topics.

In the opinion of many able men, not only the gas industry, but the empire itself, is passing through a crisis, or a series of such crices. The inventive faculty, manufacturing supremacy, financial enterprise, and commercial adaptability of the greatest living trading nation in the world is called in question, and our claim to stand in the vanguard of civilized powers disputed. Doubtless we live in changeful times, and the last two decades have witnessed numerous and startling changes in the gas industry; and, without inclining to pessimism, they furnish food for sober reflection. The effective competition in the area of illumination and power, of mineral oil (admitted duty free), the public support extended to electricity, the advent of Mond and other producer gases, the depreciation in the value of residuals, and the arsenical coke scare, also affect the question of unproductive capital. Coal booms increase the cost of the raw material, ever-growing local rates add their grievous burdens, diminishing net profit, and retarded expansion of trade all emphasize the economic conflict the industry is engaged in, and compel us to consider our position.

We find then, as a lighting agent *per se*, high-power coal gas is doomed. It is no longer necessary; better results being obtained by secondary means—improved illumination secured at less cost by the use of the "mantle." To produce gas of high illuminating power for the purpose of bunsenizing is a waste of energy; compounds of the rare earths can be heated to incandescence more economically by low-power gas—50 candles per cubic foot being easily obtained, and the end is not yet. This circumstance is fraught with important consequences. To the coal trade it means the utilization of seams of coal hitherto excluded from the gas market by reason of its inability to yield a gas of 15 or 16 candle power. Illuminating gas obtained from the richer and more expensive coals is being superseded by lower-grade gas, the calorific value of which is equal if not superior, per B.T.U. per candle power, to its richer olefiant brother. To our native coalfields the gain is immense, and not less so to the gas manufacturer who, being no longer restricted to superior high-priced gas coals—now being rapidly exhausted—can purchase an article to answer his purpose at a less cost. Again, such gas can be produced and sold at a lower figure; and assuming refinement in sulphur purification to be abandoned, less capital per ton will be employed in its production, less interest required to pay dividends, and more gas sold per consumer and per mile of main, extending its usefulness and perpetuating its well deserved popularity. Experience demonstrates that lowering the price of gas increases the consumption, while "revisions" with an upward tendency restrict and diminish its natural expansion.

Many methods hitherto neglected are open to gas companies for extending their business—such as cultivating more friendly relations with consumers, offering timely advice, testing internal pipes and fittings, preventing leakage and waste of gas, recognizing the identity of interests of buyer and seller, disseminating information as to manifold uses to which gas can be profitably applied, and the relative cost of other competing agents. The prejudice born of non-competition, against soliciting custom, should be removed; neither should the work of advertising the merits of gas apparatus be relegated entirely to their manufacturers. How few users know the enormous waste of energy in the steam-engine compared to the duty performed by the gas-motor? Gaseous fuel is supplanting the solid article, while gas companies manifest tacit indifference—witness the advent of producer and Mond gases. Coal gas is a more capable agent than any in the market, and its use should be vigorously advocated by those who have it to sell. Adequate pressure is a *sine quâ non* to successful competition. Managers have hesitated to engage in work "beyond the meter;" and thus they have left the field open to sellers of lamps, itinerant venders of mineral oil, and suppliers of electricity who are not hampered by tradition, or consider it derogatory to solicit custom. Making communication between new houses for gas should receive equal attention with water, and should, as before advocated, be free. The upkeep of burners, and, now that they can be obtained cheaply, of mantles, at cost would relieve householders of trouble, and afford satisfaction. Some enterprising companies are moving in the direction indicated. Why should not all? Extending the uses of coal gas and increasing consumption are a means of more profitably employing capital and minimizing the disproportionableness now existing.

Conclusion and Suggestions.

The author submits that the capital of gas companies is speaking generally, higher than is warranted by fact, has not its equivalent in works, and should be reduced. About 100 gas companies possess capitals abnormally high, while many have capitals exceedingly low. The present capital having received legislative sanction, it is not unreasonable to ask Parliament to give facilities to reduce it, by applying section 122 of the Companies Clauses Consolidation Act of 1845, or some modification thereof, to gas companies seeking relief from over-capitalization. It might be possible to arrange a division of surplus profits between the companies and consumers—say, by applying half the surplus profits to a sinking fund, and half in reduction of the price of gas. Where the sliding scale operates, the profit over 10 per cent. may be applied towards a gradual reduction in capital. Objection to any broad or comprehensive scheme of relief may safely be predicted, so complicated are the proprietary or other interests involved; but it is deferentially submitted that Parliament will not hastily consider such objections fatal to the proposal if presented in the form of a Bill.

Coal gas of high illuminating power is no longer necessary for artificial lighting, and its production should not be insisted upon by the authorities. Gas of 22 candle power was formerly supplied in London. It has disappeared; and 16-candle gas is now being reduced to 14-candle power. For lighting and general industrial purposes, heat has become more important than illuminating power, and calorimetrical testings will supplant the photometrical. Candle power should be lowered to suit the gas-yielding capacities of the cheaper coal, which is abundant and more easily won than deeper seams. Fastidious refinement in purification, such as eliminating carbon disulphide, which is only detectable by elaborate means and refined chemical analysis, and is not detrimental to the consumer, may be less stringently dealt with. Coal gas is a commercial article, and is sold as such. It is not required to be rendered "chemically pure," which is the highest degree of purity known to scientists and the faculty. Where this system of hyper-purification is compulsory, it necessitates the employment of more capital than would otherwise be required; and thus increases the cost of production, and keeps up the selling price of gas.

The gas-works situate within the Metropolitan area, or in

Greater London, as it is designated, are subject to the Gas Referees—a species of Roman Triumviri possessing supreme authority over suppliers of gas. Although unacquainted with practical knowledge and experience in the manufacture and supply of gas, these distinguished gentlemen possess undoubted ability, brilliant scientific attainments, and constitute a scintillant triumvirate, whose duties comprise those of examination and prescription. Thus they from time to time prescribe and certify the maximum amount of impurity in each form with which gas supplied shall be allowed to be charged, and by means of a certificate, which has all the force of a Royal mandate, can compel the Companies to effect "alteration of works," in order to remove "sulphur compounds" to a vanishing point, if, in the judgment of the Gas Referees, it is desirable. In the provinces, after the removal of ammonia and sulphuretted hydrogen, no special means are adopted to effect the removal of carbon disulphide, or "sulphur compounds," and no desire expressed on the part of consumers that this should be done, and no one is any the worse. Why London gas should be hampered, cuddled, and prescribed for, as though it were an invalid, while Provincial gas is under no restriction as to purity or freedom from "sulphur compounds" other than sulphuretted hydrogen and ammonia, is known only to the authorities. What is considered in the Provinces innocuous, is in the Metropolis condemned as injurious to health. The most efficient means of abating the smoke nuisance, which reaches its climax in London, is by using gaseous fuel. Gas-fires should be encouraged by low-priced gas, and solid smoky fuel given up. So long as the Metropolitan Gas Companies have to take the prescriptions of the Gas Referees, cheap gas, instead of being a reality, will prove too expensive for purposes of heating dwellings, &c., and smoke will continue to pollute the atmosphere, destroying vegetation, defacing ornate architecture, and shortening the period of human existence.

The Future of Coal Gas.

Having now honestly and frankly, but imperfectly, endeavoured to lay before the Institute some of the aspects of the all-important question of capital employed, the author ventures to express the hope that the discussion will be worthy of the theme, and, lest the warning notes to some may sound pessimistic, he desires to place on record his firm conviction that the potentialities of coal gas are only in an adolescent state, and exhibit no sign of fatigue in its strides towards its manhood. After its inauguration in our island home, with marvellous celerity it established itself all over the civilized world; and for nearly 100 years it has ministered to the wants of the community, and assisted in the promotion of the national prosperity, and will continue the good work in a much more extended sphere. In spite of rival illuminants, in its quiet unobtrusive way, coal gas has maintained its position, and remains the most convenient, the cheapest, the safest, and the favourite form of artificial lighting to-day. It yields over ten times more duty per cubic foot than when in its infancy; and for effective cheapness, the light of 1000 standard candles can be and is supplied at a cost of less than 2d. per hour, and we have not apparently reached the limit yet. We may even produce a luminescent agent that will supersede the incandescent mantle—*Ultima Thule* is unknown in gas. Who can foretell the next development, or predict the brilliant future of what thoughtless competitors, whose wish is "father to the thought," have amusingly named "a decaying industry!" There are no signs of decadence, but manifold indications of a healthful, vigorous, useful, extended, and durable career for the expanding science of coal gas manufacture.

Discussion.

Mr. J. West (Manchester) said there were several points in the paper on which he should have liked to break a lance with the author, who he felt was a foeman worthy of his steel; but, unfortunately, there was not time to go into it. He heartily thanked Mr. Jones, however, for having taken so much time and trouble over it; and he felt sure it would be looked upon as a valuable text-book on the subject with which it dealt.

Mr. E. Jones (Aberdare) said it was to be regretted that a paper containing so much valuable information had come on at such an hour of the day. He thought it was a pity it was not taken as read, so as to allow time for its discussion. He should have liked to see some consideration of the case of corporations as well as that of companies; for there were many points in connection with their capital which certainly required some little elucidation. In his own case, they had a large capital, which he should like to see reduced, because fully half of it was of no earthly use. They had a good reserve fund, but, unfortunately, it was put in such a way that they could not use it, except to bring in a small revenue; and consequently the capital had to be largely employed somewhat illegally. Although they claimed to make gas very cheaply, they had a large amount of capital per million cubic feet; but half of it was the amount paid for the old works, and was practically dead money.

Mr. C. E. Jones, in reply, said he thought they might learn by the experience of that morning the wisdom—or rather the absolute necessity—for circulating the papers before the meeting, and taking them as read, so as to allow time for discussion. Another Society to which he belonged had decided to adopt this course in the future. He quite agreed that the points raised could not be adequately dealt with then; and he had only to thank the members for the kind feelings which had been expressed towards himself. He regretted that he had not had the criticism which he deserved, for the paper was no doubt controversial. But if the matter came up again, by permission of the Council, perhaps twelve months hence, and he were alive, he should be glad to meet the gentlemen to whom Mr. West had referred as foemen worthy of his steel.

ESSAYS AND REVIEWS.

THE LEGAL RELATIONS BETWEEN GAS SUPPLY UNDERTAKINGS AND CONSUMERS.

(*Continued from p.* 1558.)

From the consideration of the law in regard to the use of meters, it is a natural step to proceed to the question of disputed accounts for gas supplied.

Disputed Accounts.

Justices to Determine.—The Acts of Parliament contain only one enactment dealing directly with the very important question of a dispute between a gas company and a consumer as to the quantity of gas used by the latter. By section 20 of the Gas-Works Clauses Act, 1871, it is enacted that the register of the meter shall be *primâ facie* evidence of the quantity of gas consumed, and in respect of which any rent is charged and sought to be recovered by a gas company, provided always that if the company and the consumer differ as to the quantity consumed, such difference may be determined, upon the application of either party, by two Justices (or, in the Metropolis, by a Magistrate), who may also order by which of the two parties the costs of the proceedings shall be paid; and the decision of the Justices or Magistrate shall be final and binding on all parties.

Where in the Gas-Works Clauses Acts, or Acts therewith incorporated, any question of compensation, expenses, charges, damages, or other matter is referred to the determination of any one Justice or more, any Justice may, upon the application of either party, summon the other party to appear before one Justice or before two Justices as the case may require, at a time and place to be named in such summons; and upon the appearance of such parties, or, in the absence of any of them, upon proof of due service of the summons, such Justice or Justices may hear and determine such question, and for that purpose they may examine the parties or any of them, and their witnesses, on oath, and the costs of every such inquiry are in the discretion of the Justices, who are to determine the amount thereof (G. C., 1847, s. 40, and Railways Clauses Act, 1845, s. 142.)

Section 20 of the 1871 Act, it will be seen, does not, at any rate explicitly, prescribe any method by which the Justices or Magistrate shall determine the quantity of gas consumed, nor is much guidance afforded by decided cases. It may, therefore, be well to consider somewhat carefully the various points that arise in regard to disputed accounts—premising that the settlement of a dispute by negotiation with the consumer in such a way as shall, if possible, be reasonably satisfactory to both parties (work which requires the exercise of no inconsiderable amount of tact, skill, and diplomacy upon the part of the gas company's staff, and should not be left to any but thoroughly qualified officers entrusted with a reasonable degree of discretion), is infinitely to be preferred to a reference of the disputes to the Courts of Law. There are, however, occasions when such a reference becomes unavoidable; and so that contingency must be considered.

Grounds of Dispute.—Disputes arise either through the consumer contending that the quantity of gas registered by the meter exceeds the quantity he has, or believes he has, used, or through the company requiring the consumer to pay for more than the quantity registered by the meter, on account of the latter being proved faulty. In the first case, the company's officials may be

able, after full investigation and a little judicious questioning of the consumer or his servants, to discover the occasion of the increase in the meter's registration, and to satisfy the consumer that the gas has actually been used *or wasted*. New servants, unaccustomed to the use of gas, are a frequent source of increased accounts and consequent disputes—though the case of the Irish maid who thought the gas-stove was so economical because "you don't ever need to light a match" is, fortunately, an extreme instance. Another source of augmented bills is that of loss through leakage on the internal fittings. If the escape happens to be in such a place that the gas can get away without causing annoyance—for example, on a service running through, or close to, a chimney—it may continue for some time, and only be discovered, perhaps, by a searching examination of all the fittings being made, in consequence of the meter being found to register steadily when no gas is being used. In such case, the loss is, of course, the consumer's, though he may not readily admit his liability (see *Saunders v. South Metropolitan Gas Company* heard at the South-Western Police Court on Aug. 2, 1901. "JOURNAL," Vol. LXXVIII., p. 345).

Failing the satisfaction of the consumer, by means of investigation, as to the accuracy of the meter's registration, it becomes necessary for the meter to be tested by the independent authorities appointed for that purpose under the Sale of Gas Act, 1859 (see *ante*, "Accuracy of Meters—Testing after Usage.") If, then, the meter be found correct, and the consumer should still dispute the account, there can be no doubt but that the certificate of the testing authority would be accepted as conclusive by any Justice or Magistrate to whom the dispute might be referred under section 20 of the 1871 Act. We know of no case where the registration of a meter certified to be a correct measure within the meaning of the Sale of Gas Act, when tested specially in reference to a dispute, has been made the subject of a reference to a Magistrate or Justice.

Fast Meters.—If, however, the meter be condemned as being so much per cent. "fast," the question arises—and often leads to much disputation—as to the extent of the allowance to be made to the consumer. There is no enactment upon this point in the General Gas Acts; but most, if not all, companies adopt as their rule in such cases—by way of a clause in the gas contract, or by notification to the consumer, or by a clause in a Private Act—the principle laid down in clause 34 of the "Model Gas Bill" (see "Michael and Will on Gas and Water," p. 227), namely, that, in the event of a meter being tested in manner provided by the Sale of Gas Act, 1859, and proved to register erroneously, such erroneous registration shall be deemed to have first arisen during the then last preceding quarter of the year, unless it be proved to have first arisen during the then current quarter.

Allowances made upon this principle, however, frequently fail to give satisfaction immediately to the consumer, though most reasonable consumers will admit its fairness upon having the matter put to them properly. A not uncommon contention is that the meter must have been wrong all the time it was in use. The fact that when it was first made, or when it was last repaired, it was examined and approved by the same authority that now condemns it, is fatal to that suggestion. "Then the meter has been wrong for a very long time; the consumption has been increasing for a year or more." This is another contention. The answer to this is, that if the consumer was not satisfied with the charges in former quarters, he should not have paid them until he had had the meter tested. As, instead, he paid the charges, he accepted the meter's record as correct, and has no claim at a later date.

But, when all is said, every gas manager knows that cases arise, not infrequently, in which there are very good grounds for departing from the principle of allowing for errors of registration upon the last preceding quarter only. The consumer has "grumbled but paid" in former quarters which showed an increase, until the last straw has been put on the load; or is not too business-like a man or woman, and has not noticed the increase for two or three quarters; or—other reasons which will cause the diplomatic manager to make an exception, without admitting liability for more than the regulation deduction. It is, indeed, very necessary in the management of large business concerns—for the smooth and regular working of which it is essential that rules should be laid down to guide the staff under the ordinary circumstances of the particular business—for the managers to remember that the rules are made for the good of the firm, and not to be an impediment to rational dealing with customers. The manager who cannot break a rule is not fit to make one.

Unfortunately, the gas industry has got a reputation—in some places much more notoriously than in others—for preferring consistency to common sense in regard to the administration of rules and regulations originally designed for and generally, but by no means necessarily in all circumstances, conducing to, its benefit. When a consumer asks for the bread of an equitable settlement, he is not always to be satisfied with the stone of "our invariable rule." It is a very barren victory to wring from a reasonable customer a payment he has cause to think excessive, when by so doing he is rendered for all time a man with a grievance against the gas company. These remarks apply equally, of course, to the matter of surcharges as to that of allowances; but before dealing with disputes arising from surcharges, we have to consider the case of a reference to the Courts of a dispute as to the allowance to be made for a meter condemned as fast. The vital question here is this: Is the Court (the Justices, Magistrate, or County Court) bound by the certificate of the testing officer as to the degree of inaccuracy of the meter?

As a case reported in the "JOURNAL" only so recently as the 20th ult. (*ante*, p. 1364) shows, County Court Judges and Juries do not always hold themselves so bound; the Jury in the case of *Faversham Gas Company v. Knowles* awarding the defendant a rebate of £3 9s., whereas the allowance made by the plaintiffs in accordance with the report of the London County Council Examiner was only 8s. It may be remarked that, inasmuch as the Gas-Works Clauses Act, 1871, section 20, provides for the settlement of disputes as to consumption by two Justices, a gas company having such a dispute with a consumer is very ill-advised if it refers it to a County Court for judgment, as in that Court the consumer can elect to have the case tried by a Jury; and to expect a Jury consisting entirely of gas consumers to take an unprejudiced view of such a dispute, is to display an undue amount of faith in the average man's capacity for being impartial. A Magistrate or two Justices may generally be relied upon to decide the dispute upon the merits of the case; whereas a Jury of shop-keepers, however much they wished to be just, must, in the nature of things, see the facts through consumers' eyes. It is, further, a question as to whether a company could not plead that an action to determine the amount payable for gas consumed is wholly or in part one of "mere account," and, therefore, under the Common Law Procedure Act, 1854, s. 3, "not conveniently to be tried in the ordinary way,"—that is to say, by a Jury. (See *Birmingham and Staffordshire Gas Company v. Ratcliffe* [1871] L. R. 6 Ex. 224.) Where the matter in dispute is held to consist "wholly or in part of matters of mere account," the Court may decide the case in a summary manner, or refer it to an Arbitrator appointed by the parties, or to an officer of the Court, or, in country causes, to the Judge of any County Court; and the decision or award of such Court or Arbitrator is enforceable in the same manner as the finding of a Jury.

There is, it should be noted, a decided case, argued by Counsel before a Metropolitan Magistrate, upon which gas companies may well rely in the event of having to submit a fast-meter dispute to litigation—namely, that of *Cresswell v. Gaslight and Coke Company*, fully reported in the "JOURNAL" for Nov. 2, 1897, which was a summons taken out by a consumer under section 20 of the 1871 Act, in order to obtain a magisterial settlement of a dispute which had arisen between him and the defendants as to the quantity of gas chargeable to him. The meter was tested and certified to be 2·46 per cent. fast, whereas the increase in registration was much greater. The Company endeavoured to satisfy the consumer by making the allowance on two quarters' consumption instead of one, but to no purpose; and the matter then, as stated, was referred to Mr. Horace Smith for his decision. Judgment was given in favour of the Company, whose Counsel (Mr. Horace Avory) addressed his arguments entirely to the question of whether or not the test of the London County Council was binding. We quote from the "JOURNAL" report:

> He [Mr. Avory] wanted his Worship's decision upon a matter of great importance to the Company—namely, what was the meaning of the words in section 20 [of the Gas-Works Clauses Act, 1871]—"the register of the meter shall be *primâ facie* evidence of the quantity of gas consumed." It seemed to him to mean that every meter should be assumed to be correct, and that its register should be *primâ facie* evidence that the quantity of gas recorded by it had been burnt. Of course, this could be disputed, and then the meter might be tested. But if, after this had been done, the register was still to be only *primâ facie* evidence which could be rebutted by the statement of a consumer that he did not think he had burnt so much gas as was recorded by the index, then a separate Court would have to be set apart for the settlement of these disputes. . . . His Worship was asked to settle the dispute by finding what was the actual quantity of gas consumed by the complainant in the March quarter. What possible evidence was there upon which he could base a decision on the point?

It would, indeed, be a serious matter for gas companies if the question of what quantity of gas has been consumed were to be open to decision by a Judge or Jury upon evidence which, in the nature of things, the gas company could not possibly refute, when the registration of the meter has been found correct, or has been amended in accordance with the percentage of error found by the meter inspector to exist. (It should be noted that Mr. J. G. Glover, of Messrs. Thomas Glover and Co., Limited, who gave evidence in the Cresswell case, declared that "if a meter inspector, having made his test carefully, said a meter was only 2 per cent fast, that meter could not, under any circumstances, no matter what the pressure might be, register more than that quantity fast. The inspector's test was a perfect one.") The judgment in the Cresswell case is, therefore, of much importance [it is, strangely enough, not noticed in "Michael and Will"] and should be borne in mind by all gas managers when similar disputes arise with "impossible" consumers—by which we mean consumers who are, as some few in almost every town or city are, impervious to reason and disputatious to a degree. No dispute with a reasonable man ought ever, in our opinion, to come to a question of the Law Courts, unless by way of a "friendly" reference to a Magistrate if a very considerable sum is at stake, and neither party feels justified in coming half way towards the other. Such cases are, however, extremely rare.

Meters Registering Less than Consumption.—If the gas company challenge the registration of a meter, and upon being legally tested it be found so much per cent. slow, the company can, if

the amount of the deficiency be worth charging—taking the risk of trouble with the consumer into account—surcharge that percentage upon the same lines as it would make a rebate if the meter proved fast; and what we have said as to the certificate of the inspector being conclusive evidence in the case of a fast, would equally apply to the case of a slow, meter. But meters are often found to be defective, in favour of the consumer, in other ways than that of being merely a percentage slow. The meter may have "ceased to register" altogether; or does not register up to a certain hourly consumption, but with a greater consumption registers correctly (usually stated in the official certificate as "found to register correctly at its capacity, and to pass [say] 24 feet per hour unregistered gas at 30-10ths pressure"); or it may be declared not to register up to a certain hourly consumption, and thereafter to register a percentage slow, or even fast. All that can be asserted with any confidence when any of the foregoing verdicts is pronounced upon a meter is that the number of feet registered by the meter does not in all human probability represent the number of feet actually consumed. The meter inspector's certificate provides no basis whereon the consumption can be estimated; so the delicate, and oft-times difficult, task devolves upon the company of arranging with the consumer as to what charge shall be made in respect of the last preceding quarter.

In many cases the consumer will agree without demur to being debited with an average of three or five years' burnings; and, especially if the consumption of gas in past years has been regular, this method of arriving at the probable consumption is a useful and proper one. Sometimes it will be claimed that the lowest recorded consumption in the corresponding period of former years would be a fair charge—and policy will probably dictate the acceptance of such an offer, if at all reasonable. One thing may be taken for granted. In any period for which it is necessary to estimate the debit against a consumer, that consumer will have done less business, or been more away from home, or have kept less company, or have gone to bed earlier, or have had more economical servants—will, in short, have used less gas—than in any other quarter he has had dealings with the company. And if the fact that the meter put up in place of the faulty one shows that as much gas is being used as ever was, is gently pointed out to the consumer, it will always be found that, by a strange coincidence, immediately the meter was changed, business improved, or the consumer's mother-in-law came to stay with him, or the baby was taken ill, or a new gas-fire was fixed—something, in fact, happened to double the use of gas.

These "facts" (which go far to make a gas manager believe that fact is stranger than fiction) it is exceedingly difficult for the company to challenge, and almost impossible for them to disprove; and it may be taken pretty much as a matter of course that, in eight cases out of ten, the company must be prepared to accept considerably less from the consumer than they actually estimate he should pay, as, even if they wished to carry the matter to an issue in the Law Courts, they would be seriously handicapped by the impossibility of satisfactorily disproving any evidence adduced by the consumer.

The only case over which a gas company would, generally speaking, go to law would be one of complete refusal upon the part of a consumer to pay for anything beyond the meter's record, and then only if it were perfectly clear that more gas had been used, and if the amount of the estimated deficiency were appreciable. But while, as we have said, it will not generally be politic for a company to stand out for its full pound of flesh in the matter of defective meters registering against the seller, it appears to us that it was mainly with a view to providing the necessary legal machinery for settling such cases that section 20 of the 1871 Act was framed, and that that section was not intended to give the Justices or Magistrates power to determine, by some rule-of-thumb calculation which ignores the certificate of the meter inspector appointed under the Sale of Gas Acts, the amount payable by a consumer when a meter is found fast. Whatever use is there in the provisions of the Act for the testing of meters in case of dispute, if the result of such testing is to be calmly ignored by a Judge or Jury? So gas companies should, in our opinion, take a strong stand against any such method of settling disputed allowances if they are obliged to take them into Court; and, if only the matter be properly argued by counsel—and the Cresswell case facts and judgment laid before the Court—we do not believe that an adverse verdict will ever be given.

Appeal on Point of Law.—Any person aggrieved who desires to question a conviction, order, or determination, or other proceeding of a Court of Summary Jurisdiction, on the ground that it is erroneous in point of law, or is in excess of jurisdiction, may apply to the Court to state a special case, setting forth the facts of the case and the grounds on which the proceeding is questioned, and, if the Court decline to state the case, may apply to the High Court of Justice for an order requiring the case to be stated. The application must be made, and the case stated, within such time, and in such manner, as are from time to time directed by rules made under the Summary Jurisdiction Acts; and the case shall be heard and determined according to rules of Court in pursuance of the Supreme Court of Judicature Act, 1875 (Summary Jurisdiction Act, 1879, s. 33).

Disputes with Local Authorities as to Consumption of Gas.—Section 27 of the Gas-Works Clauses Act, 1871, provides that any difference which may arise between a gas company and any local authority in relation to the supply or consumption of gas to or by such local authority shall be from time to time settled by arbitration, in manner provided by the Companies Clauses Consolidation Act, 1845, with respect to the settlement of disputes by arbitration.

Gas Supplied to Public Lamps.

It may here be noted that if the gas is supplied to the public lamps in any district by "average meter indication"—that is to say, by the consumption of all the lamps being calculated from the average consumption of a few to which meters are attached—the company must, in order to secure uniformity of consumption between metred and unmetred lamps, from time to time provide the public lamps in their district with proper self-acting pressure regulators and burners to the satisfaction of the local authority; and the average amount of the indications of all the meters attached to the lamps in that district shall be deemed to be the amount consumed by each such lamp; unless any dispute arises between the company and the local authority, when the consumption is to be settled by arbitration, as stated above (G. C., 1871, s. 25). The company or the local authority may, at their own expense, affix street lamp-governors to the public lamps, and the other party is entitled to have access to such governors for the purpose of examining them (G. C., 1871, s. 26).

(*To be concluded next week.*)

ENGINEERS AT THE CRYSTAL PALACE.

A special feature in connection with the proceedings of the Society of Engineers, as is well known, are the series of Vacation Visits which are arranged to take place each year. The primary object of these visits is, of course, to add to the technical knowledge of the members by personal inspection of notable works of engineering; but though business comes first, pleasure is also made welcome on these occasions. The first visit for the present season was fixed for last Wednesday, when a party of thirty gentlemen journeyed to the Crystal Palace, for the purpose of examining portions of that great undertaking which (though passed by unheeded by the ordinary sightseers) are of considerable interest from an engineering point of view.

On arriving at the Palace, the attention of the party was first directed to the School of Practical Engineering, situated in the South Tower, which was established in 1872, for the purpose of providing students of mechanical or civil engineering with thorough practical instruction in the rudiments of the profession, and in the manipulation of materials. The school has, however, since been largely extended; and students now go through a comprehensive course of combined practical and theoretical instruction. The mechanical and civil engineering course extends over two years; and as the average number of pupils is between eighty and one hundred, it will be seen that the school fulfils a very useful purpose. The members were shown by the Principal (Mr. J. W. Wilson) and the Vice-Principal (Mr. Maurice Wilson) over all the offices and shops, in which pupils from every part of the world were busily engaged; and the plans, &c., exhibited amply testified to the efficiency of the training they receive.

After the inspection, the party assembled in the Lecture Theatre (where light refreshments were kindly provided for them), to hear a few remarks by Mr. J. W. Wilson upon points of interest to those present. Referring first of all to the new roof which has lately been constructed upon the "Eclipse" system of Messrs. Mellowes and Co., over the centre transept, Mr. Wilson said that this was the outcome of the continual expense incurred by the Company in maintaining the old one, which was brought down to Sydenham from the Exhibition of 1851. The old roof was originally put up in a great hurry; and so the first point to be decided was: What was the largest size piece of glass that could be obtained at short notice? The size eventually determined upon was 49 in. by 10 in. Since it has been at Sydenham, an army of men have been constantly employed repairing the roof; and on the reorganization of the Company, about four years ago, part of the money forthcoming was spent in restoring the portion over the centre transept. The main framing was left; but the old Paxton gutters and ridges were removed, and Mellowes and Co.'s system was substituted. This method consists in employing a steel T-iron (with little grooves for moisture if necessary), entirely encased in a drawn coating of lead with an admixture of tin. There were flaps which could be moved; and when the glass was put in, these were pressed down. With this system there was supposed to be nothing to maintain, as the lead did not want painting and the steel was protected. Then another advantage was that thicker glass was used, measuring 51 in. by 18 in. The roof of the Palace was 14 acres in extent; and if the Company could put up a complete new roof requiring no maintenance, this would, of course, be a very important consideration. There was, however, a problem in applying this system, for the Palace was not a rigid structure. It was the biggest roof of the kind in the world; and when the wind blew it all rocked. There was thus motion in the roof; and therefore the system had to be proved, as regarded rigidity. Turning to the water supply of the building and grounds, Mr. Wilson remarked that this was much more interesting than people generally had a chance of realizing. First, there were the water-towers, which were not at the Exhibition of 1851. These towers (which were originally begun from other designs, but

before they were finished had to be pulled down again, as they commenced to fall to pieces) were planned by Brunel; and it was said that he obtained his idea from a tower at Monmouth, in the Valley of the Wye, which was partly put up by a gentleman many years ago, but never completed. The South Tower at the present time is about 11 inches out of the perpendicular; the boring of the railway tunnel beneath having caused it to settle, but not quite evenly. It was, however, reassuring to learn that, since it first settled, there has been no further movement. Mr. Wilson then briefly described the pumping machinery, &c., stating that though this might not be considered modern, it would be by no means a waste of time to look at it.

On leaving the School of Engineering, the party proceeded to examine the new roof, under the personal guidance of Mr. Carr, the Company's Engineer. After spending some time in this way, a move was made to the North Tower pumping-house, where there are a pair of beam-engines, with pumps of the bucket-and-plunger type, and each having two hydraulic cylinders. The larger pump cylinders are used for raising water from a large reservoir close by to low-level tanks; the smaller cylinders are employed to pump the water from the reservoir to the top of the tower. Both these hydraulic cylinders are, in the case of each engine, worked from one end of the beam; but one only is in use at a time. These engines are dated 1853; but on Wednesday they appeared to be working as well as ever they could have done. At the lower pumping-station, there is a cross-coupled double horizontal pumping engine, for raising water from the boating lake into the reservoir or tanks near the North Tower. This engine was also made in 1853-4. The two steam cylinders drive direct the piston-rods of two double-acting pumps; and by means of curiously-shaped fork connecting-rods, the two piston-rods are connected to the two cranks of a shaft carrying a fly-wheel, placed at the opposite end of the engine to the steam cylinders, and a jet condenser is worked from a crank connected to the piston-rod. Most of the water is derived from the rainfall collected the on grounds (nearly 200 acres being available as catchment area); but a portion of it is obtained from a well 250 feet deep, having three boreholes sunk from the bottom to a further distance of 250 feet. At a depth of 150 feet in this well, there are four headings, varying in length up to 30 feet. The ordinary water-level is at a depth of some 95 feet from the surface; and the yield is about 40,000 gallons a day. The total quantity of water needed for the Palace is, however, over 250,000 gallons a day, exclusive of any used for dietetic purposes; and there are no less than 25 miles of pipes connected with the supply. In dry years, the amount available is not equal to the demand, and recourse is then had to the Lambeth Water Company. The main storage reservoir is the boating lake; and the water in the tanks at the top of the two towers (the combined capacity of which is nearly 600,000 gallons) is treated almost entirely as a reserve in case of fire, though a portion of it is used for special purposes. Reckoning 30 gallons per head per day, the quantity of water needed to meet the requirements of the Crystal Palace would be sufficient to supply a town of between 8000 and 10,000 inhabitants. The water supply of such a building is therefore a matter of much greater magnitude than would generally be supposed.

At the conclusion of the dinner which followed the inspection, Mr. Percy Griffith, the President, on behalf of the Society, cordially thanked the Crystal Palace Company, Mr. W. Gardner, Mr. Carr, and Messrs. Wilson for the great attention received at their hands. The outing was a most successful one in every way; and the value of the visit was very greatly enhanced by Mr. Carr and Messrs. Wilson, who were indefatigable in their endeavours to perfectly explain every matter of interest to the members.

ELECTRIC LIGHTING MEMORANDA.

The "Electrician" Disagrees with our Views of Electric Traction—The Example of Bristol—The Rule of Profitable Electrization—Analogy with Municipal Electric Lighting.

THE "Electrician" has met in a kindly spirit the further statement of our views on the subject of municipal electric tramway working, which constituted the bulk of last week's "Memoranda." It is therefore with enhanced pleasure that we return to the subject, determined to give our contemporary's observations all the respect they deserve. They begin with a really remarkable admission. The working results of the electric tramways of both Liverpool and Birmingham are thrown overboard, as though they were utterly foreign to the issue! In order that there should be no mistake on this score, the "Electrician" actually goes the length of remarking: "Thank goodness, electric traction does not depend on what they do down at Liverpool or Birmingham." Why this scornful attitude towards two cities which are not exactly negligible quantities in the life of the nation? If the statistics had been of a different character, would they not have been quoted by electricians in support of their cause? Most assuredly they would; and until good reason is shown why this ought not to be done, we shall persist in recognizing them as valid in this controversy. Having asserted thus crudely the right of selection among data furnished by municipal electric tramway workings, the "Electrician" cannot object to criticism of its own chosen examples. It immediately—albeit, in some verbal confusion—names Bristol. This is a questionable case. There are no recent accounts available to prove what the Bristol electric tramways are doing, financially; but the undertaking lends itself to a few pertinent comments.

Bristol, it should hardly be necessary to explain, proved to be one of the cities least suited of all in the land for horse tramways. The gradients are so severe that it was found to be practically impossible to work the horses on some of the lines at all; and there was no route upon which extra, or "cock-horses," as they are called in the expressive language of the street, were not required. Electrization came as the salvation for the whole enterprise; and the first line laid down opened up a new district altogether, to the immediate advantage of the congested city—one of the most densely peopled in the kingdom. This example, in short, proves the rule. We make no claim to having discovered this rule, which is almost a commonplace of transportation polity. It is, that *where and when electric traction pays, whether for tramways or railways, it is by reason of increase of traffic, not by its own relative cheapness as compared either with horse power for the former, or steam locomotives for the latter.* All experience hitherto gathered supports this rule. Professor Carus Wilson enunciated it in his paper on "Electrical Traction on Steam Railways in Italy," read before the Institution of Electrical Engineers on the 15th ult. His conclusion on the evidence is, as our contemporary itself puts it, "in order that the electric service may be a paying one, there must be a considerable growth in the volume of traffic." That is our case. We will present our contemporary with yet another bit of evidence on the same side, drawn from its own columns. It finishes a capital description of the Cardiff Corporation electric tramways, with the information that "since the opening, the traffic on the electric cars has been enormous, and they have already become very popular in the district, the public realizing the greater facilities offered them for getting about."

This is, in truth, the conclusion of the whole matter. Profitable working is entirely a question of the volume of traffic. Traffic cannot be made where it does not previously exist, excepting in the typical case of the development of a neglected suburb of a congested town. Even then, the potentiality of the traffic may be said to have existed. What positive lack of traffic is, can be seen in the mid-day, and nightly experience of the City and Waterloo electric railway. We have always granted that the capacity of horse tramways to deal with more than a certain volume and kind of traffic is limited. The capacity of electric traction in the same circumstances is greater; but only in degree. Contrariwise, where the traffic is below a particular volume, and cannot be increased by running a quicker or more frequent service, electrization will not pay. All this is so obvious to engineering judgment, that we are surprised to find influential technical periodicals, like the "Electrician," pretending to dispute it, and to maintain that there is intrinsic economy in electric tramway traction against all rivals and in all cases—except such insignificant examples as Liverpool and Birmingham. This is the same hollow pretension that they kept up, so long as it would last, in regard to the undertaking of independent electric lighting by local authorities. Here, again, the issue is of particular interest for the industry with which the "JOURNAL" is identified. Time was when every little hamlet that applied for an Electric Lighting Order on its own account, regardless of its circumstances, was applauded as having thereby entered upon the highway of progress leading straight to financial prosperity. We denied this; and were reviled and flouted for our pains.

This all went on for years; when suddenly the tables were turned. Electricity generation "in bulk" came into fashion; and forthwith the electrical soothsayers tumbled over one another in their zeal for the new evangel. Infinite scorn was poured upon the miserable little parochial authorities who, having just obtained Electric Lighting Orders of their own, at what to them was a heavy expense, objected to having their districts invaded by big trading companies. The very advisers in the Press and on the platform who had a few months before awarded them the palm of progress, now stigmatized them as reactionaries; and it was gravely discussed in places where they do this kind of talking, whether the national prosperity was not gravely imperilled by this municipal particularism! As it was with early municipal electric lighting, so it is now with the municipal electrization of tramways. It is good sometimes, but not always, nor everywhere. It is never cheap; but this may not always be a controlling consideration. We are content to rest our criticism on all the trustworthy electric tramway and railway traffic returns that can be produced, from those of Central London tube line downwards; and we repeat the statement that in every one of them the working expenses disappoint the expectations that were so confidently encouraged five or six years ago.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see p. 1700.)

THE general position of affairs on the Stock Exchange continued last week much the same as in the week before, and the process of shaking out the weak operators for a rise was carried on ruthlessly. This, of course, sent prices down, and the depressing weather had a lowering effect also. Thus, with the exception of one or two bright spots, the array of quotations suffered a setback. The settlement was a heavy and anxious one, and probably disastrous to not a few. In the Money Market, there was a stiff demand, but no degree of stringency; and there seems to

be no likelihood of tightness in the immediate future. In the Gas Market, the recent average volume of transactions was fairly well maintained, though on some days the rate of activity slackened somewhat, and a very large percentage of the business was confined to the leading undertaking. The prevailing tendency was favourable, and of the considerable number of alterations effected in quotations, all, with one single exception, were in the upward direction. In Gaslight issues, the advance in the ordinary which was so nearly accomplished the preceding week now came off; and the price which opened at 93⅜ rose to 95¼, and closed firm thereabouts. Business in the secured issues was only moderate, and the prices were moderate too, except for the debenture, which advanced. South Metropolitan was very lightly dealt in; but it pushed on its advance—gaining two points, and changing hands at 124. Nothing at all was marked in Commercials; but both the old stock and the debenture had a rise. In the Suburban and Provincial group, Brentford debenture and West Ham improved—the latter more in response to transactions at the Mart than in Capel Court. In the local Exchange, Liverpool added two more points to its recent advance. Business was very quiet in the Continental Companies, and Imperial had a slight fall; but Union recouped a portion of its late losses. Among the remoter undertakings, there was no change, except those arising from *ex div.* adjustments. In the Water Companies, business was remarkable only for the irregularities in quotation movements. East London, Grand Junction, and Lambeth advanced; while Southwark and West Middlesex receded. But a feature in them all was the firmness of debenture and preference issues, in response to the general inquiry for gilt-edged securities—a demand which is likely to increase rather than diminish.

The daily operations were: Gas opened fairly active on Monday, and prices were good. Gaslight debenture, Commercial old, and South Metropolitan gained 1 each. In Water, East London rose 2, and Lambeth 2½. Tuesday was rather quieter, but equally firm. Gaslight ordinary and South Metropolitan improved 1 each. Wednesday was much the same. Continental Union rose 2. Thursday was a slacker day, and Imperial receded 1. Several *ex div.* changes are noted in the list. Friday recovered some degree of activity. West Ham advanced 1. Saturday was firm and unchanged.

WATER-METERS AND WASTE PREVENTION.

The Water Department of Detroit (Mich.) for some years furnished data in regard to the consumption and waste of water in the city, the use of meters, and similar subjects of interest. Unfortunately, certain of the earlier figures published, especially those relating to the prevention of waste by the use of meters, were declared to be misleading, by Professor Gardner S. Williams, who was the Civil Engineer to the Department for a long time; and some remarks of his on the subject, contained in a recent number of the "Proceedings of the American Society of Civil Engineers," have been reproduced, with other particulars, in the "Engineering Record." The Professor states that it has been frequently asserted in official publications that the reduction of consumption from the maximum in 1888 to the minimum of 1892 was due to the saving of water caused by metering. The quantity of water paid for by meter in 1889 was only about twice that similarly paid for in 1888; and yet the saving was nearly twice as great during the following year, when four times as much water was sold by meter. Beyond 1890 the increase in metered water had very little bearing upon the variation of the consumption. These facts Professor Williams considers sufficient to arouse suspicions as to the remarkable efficiency claimed for the meters; and when it was found, by a computation of the discharging capacity of the connections metered in 1889, that if they had all been running wide open 24 hours in the day in 1888, and until metered in 1889, and had been closed completely during the portion of 1889 after the meters were set, the amount they would have reduced the consumption by would not begin to account for the saving claimed, it became evident that some other cause of reduced consumption was to be looked for. Upon investigation, it was found that the bulk of the saving between 1888 and 1892 was due to restriction of waste at the engines themselves, and had no connection with the meters further than this—that it was instituted at the same time and for the same purpose as they.

It appears that prior to 1888, it was customary to open the waste-gate at the pumping-engines, and pump back into the river, rather than lay off an engine at night, when the consumption fell below a certain point. When the engines were slowed down to nearly their minimum capacity, the attendants opened the waste-gates, discharging back into the pump well, to keep them running during the night. Professor Williams notes the decided jump in consumption from 1886 to 1887; and by tracing this back, it was found that it began at the time the reservoir was cut off from the system. Up to October, 1886, the Detroit system was a combination of reservoir and direct pressure; the water being pumped straight into the mains, but the reservoir being so connected that a surplus accumulated there, so that then it was not necessary to waste much water, because generally there was a chance to pump 8 or 9 feet depth of water into the reservoirs at the times when the consumption was low. But the reservoir was disconnected from the system in 1886, because it was felt that it did not afford opportunity for sufficiently high pressures, and an increased waste at the engines commenced immediately—the jump being noticeable the very first day after the reservoir was abandoned; and the waste continued to increase until, in 1888, it had become so great that the Board of Water Commissioners were appalled at the quantity of water which they were pumping, a large portion of which was never getting to the city at all. They feared they would have to reconstruct their entire system within five years; and the only alternative appeared to be to introduce meters, which they began to do at once.

There were some notable cases of reduction of consumption when the first meters were put in, but nothing that would account for anything like the drop which actually took place. Simultaneously with the introduction of the meters, the waste at the engines was curtailed, and as little water was wasted there as could be with the devices that existed for controlling the machinery, for there were times when it was necessary to waste some water. In 1893, when the Professor's connection with the works began, he had a record kept of the opening of the waste-gates—the time during which they were open, the number of turns, &c.—and began estimating the quantity of water wasted in that way; and although it was then supposed that there was no waste, or at least that no more water was wasted than was absolutely necessary, it was found that the waste-gates sometimes discharged anything from 500,000 to 2,000,000 gallons a day. When this waste was so great under these conditions, it can readily be imagined that considerably more had been wasted when there was no attempt to restrict the quantity so lost. Comparisons between Sunday and week-day consumptions in 1888 showed that from 7 to 10 million gallons had been wasted daily on some occasions. In 1894, the engines were remodelled; and by 1895 they were so arranged that it was unnecessary to waste. Since early in 1895, there had been no loss of water pumped at the engines in the Detroit works.

So much for Professor Williams. In 1897, the policy of the Water Commissioners in the matter of waste was abandoned, and private houses were no longer metered. The result is stated in the report for 1900-01 of Mr. H. S. Starkey, the General Manager of the works, substantially as follows: The daily consumption per head for 1900 was 153 gallons—an increase of 6 gallons over 1899. For 1897, it was 125 gallons; for 1898, 135 gallons; for 1899, 147 gallons; for 1900, 153 gallons; and for the first six months of 1901, 163 gallons. Since 1898 comparatively few meters have been placed, and Mr. Starkey believes the increase per head each year is largely due to this fact. The enormous waste in Detroit is apparent by comparison with the quantity of water consumed in Milwaukee; the population of that city, as shown by the last census, being but 200 less than Detroit. Presumably the uses for water are the same in each city. Milwaukee has 68 per cent. of the taps metered; Detroit has 10 per cent. In 1900, the consumption per head in Milwaukee was 88 gallons; in Detroit, it was 153 gallons—a difference of 42½ per cent.

In the report of Mr. T. R. Putnam, the Superintendent of Meters and Inspection for the same time, there are some additional statements concerning the subject, indicating that Detroit is returning to its former policy of metering—perhaps not so much to prevent waste as to make wasteful users pay for their carelessness. According to his figures, in the eighteen months following Jan. 1, 1900, he placed 366 meters, and removed 286, making a net increase of 80, which, added to the number in service previous to that date, produces a total of 5635 in service on July 1, 1901. There were then 807 meters on premises, of which the owners paid by assessed rates, as against 1113 eighteen months before. There were 130 meters removed from such premises and fixed on business places which required metering; and 176 consumers who changed from meter to assessed rates, where the meters were allowed to remain on the premises, were transferred back to the meter roll on account of their large consumption. A case in point is that of a private family where the consumption was 435,000 gallons in three months, which, by meter rates, would amount to $10·83, while the assessed rate for the same length of time was only $1·78. After placing premises on the meter roll, the consumption was reduced to 9000 gallons for three months, instead of 435,000 gallons as formerly. This is not an uncommon occurrence on metered premises. It seems to be the experience of nearly all cities throughout America, and is causing many of them to adopt the meter system; this being the only practicable way of stopping the enormous waste that is continually taking place.

When meters were first being introduced in Detroit, the idea was that their life would be about ten years; but after the lapse of that time, those which have been in service that number of years, are, according to our American contemporary, to all appearance, still as good as ever. The department deducted 10 per cent. per annum for several years for depreciation in value, and later reduced it to 5 per cent., which amount is now regarded as too high. A 4-inch meter was recently removed from an abandoned service; it had been in constant operation for upwards of ten years, and had registered more than 78 million gallons. It had been repaired only once—the disc having been adjusted and the train gear repaired, all of which was done in less than a day. It was tested with a new 1½-inch meter, and on 750 gallons it was only 0·5 per cent. slow, and this before anything had been done to it in the way of cleaning or repairs. On a ⅝-inch stream, it was about 4 per cent. slow; but after it had been cleaned and adjusted, it registered within 2 per cent. on a flow of ⅛ inch.

In the course of his report, Mr. Starkey remarks that, in considering the subject of water waste, the matter of house-to-house inspection deserves consideration. It appears that during the last three years, on account of the inspectors' time being taken up with other things, it has been found impossible to give proper attention to house inspections for leaks. While examination of private premises causes annoyance and irritation to the citizens, it seems, at present, a necessity. Great objection is made to admitting strangers into premises; and though the inspectors are provided with proper credentials showing their authority, many complaints have been received that men, claiming to belong to the Water Department, have gained admission to premises only to attempt to sell filters, attachments, &c. This objection could be remedied by placing meters on all premises supplied with fittings. Leakages would soon be repaired if payment for waste were required.

In the report of the Commissioners for the period covered by Mr. Starkey, the gradual adoption of the meter system is recommended; and the following plain statement is made of the position: "There is no desire on the part of the Board to restrict in any way the most liberal use of water for all legitimate purposes; but there is no necessity that the people should be compelled to pay for waste that is a benefit to no one."

LIGHTING AT THE PARIS ALCOHOL EXHIBITION.

THE Salle des Fêtes of the 1900 World's Show in the "*Cité Lumière*," as the French capital is often designated, has lately afforded a brilliant demonstration of the capabilities of methylated alcohol for lighting purposes. The building, into which no great amount of daylight penetrates, was still further darkened by Oriental hangings, so as to display to the best advantage the bright, yet soft, light shed by the lamps of great variety, burning either pure or carburized methylated spirit, shown by no less than 44 exhibitors, in addition to whom the Jury awarded an extra medal to M. Laurent, for his application of electricity and the use of carburized air to lighting incandescent alcohol lamps at a distance.

The middle of the floor space was converted into a grass-plot with clusters of choice rhododendrons, the various tints of which were not changed by the light thrown by the alcohol lamps on the stands round the circumference, and also from the dome, which was lighted by lamps of the two principal systems represented—viz., the "Washington" and the "Kornfeld." These two lamps of great power, with independent receiver, that of M. Denayrouze with a receiver under pressure, a regenerative lamp of the last-named, and also of MM. Decamps et Cie. with a lamp burning pure alcohol, shown by La Continentale Nouvelle, were awarded gold medals by the Jury, presided over by M. Michel Lévy, a member of the Institute.

The greater portion of the lamps exhibited, or at any rate those which received prizes, burn pure methylated alcohol, and certain of them the same spirit with different degrees (35° to 60°) of carburization; while some burn one or the other variety of spirit indifferently. The alcohol used for lighting and other industrial purposes is sophisticated by the addition to a hectolitre (22 gallons) of spirit concentrated to 90° or 95°, of 10 litres (2 gallons) of methylene, and 0·5 litre (nearly a pint) of what is known as *benzine régie*. The methylene is a mixture of methylic alcohol boiling at 66° C. with 20 per cent. of acetone boiling at 56° C.; and the *benzine régie*, which is not the substance called benzine or benzol by chemists, is a mixture of homologous substances such as toluene and cymene. On the other hand, the true benzine, which is used to carburize alcohol for giving it a higher illuminating power, is extracted from coal tar. But alcohol is never carburized with petroleum products which do not dissolve in alcohol.

We are reminded by M. Lombard that the first application of methylated alcohol was to lighting purposes, which, according to M. Mallet's "Dictionnaire des Arts et Manufactures," was made so early as 1832. The reason why utilization of the spirit for lighting has not made so great progress in France as it has in Germany is attributed by the former authority to the agent used for sophistication—viz., methylene—which not only is expensive, but also has the disadvantage of possessing low calorific power. A French law, which has been in force since the beginning of the present year, bestows a premium on methylated alcohol, intended to compensate for the cost of sophistication, while the industrial spirit is exempted from registration duty, so that it can now be sold for about 35 frs. per hectolitre (1s. 2½d. per gallon).

Methylated alcohol is composed of 41·5 per cent. of carbon, 13 per cent. of hydrogen, and 45·5 per cent. of oxygen; while its heating power is 5870 calories per kilogramme (10,500 B.T.U. per pound), its density at 15° C. (59° Fahr.) ·832, and its boiling-point 77·5° C. In opposition to what was observed above as to most of the lamps which are exhibited, or which received awards, consuming pure methylated alcohol, M. Lombard states that, in most cases, a hydrocarbon is used of nearly equal density, but containing a large proportion of carbon, and the formula of which is C_6H_6. This hydrocarbon therefore contains 92·3 per cent. of carbon and 7·7 per cent. of hydrogen; its calorific power being 8460 calories per kilogramme (15,228 B.T.U. per pound) and its density being ·885.

In lamps with free flame (non-incandescent), the addition of benzine to alcohol greatly reduces the consumption for a given illuminating power, as shown by the experiments of M. Soret. To obtain a light of 10 standard candles per hour one requires 1·121 kilos. (2 lbs. 7 ozs.) of 90° alcohol, 0·11 kilo. (3·8 ozs.) of a mixture consisting of 100 parts of alcohol and 20 of benzine, 0·063 kilos. (2 ozs.) of one of 100 parts of alcohol and 40 of benzine, and only 0·043 kilo. (1·4 ozs.) of 100 parts of alcohol with 60 of benzine. Alcohol contains 415 C, 130 H, and 455 O, and benzine 923 C with 77 H; so that mixing these two substances in equal parts will produce a liquid containing 670 C, 103 H, and 227 O, with a greatly increased calorific power. Accordingly, observed M. Deffays and M. Pettet, while not approaching the quantity of carbon contained in petroleum, alcohol carburized by benzine will contain sufficient carbon to permit dissociation of the elements and precipitation in the flame of carbon in a free state; and the excess of carbon and hydrogen will raise the precipitated carbon to incandescence—the consumption being from 6 to 7 grammes of carburized alcohol per candle per hour.

In incandescent lamps, remarks M. Lombard, the alcohol is gazified in a small boiler, often consisting of a mere tube; the alcohol being brought up to it by ascent or descent. In the former case, it rises by the capillary attraction of the cotton wick, or by internal pressure, given either by heating the metal parts of the lamp, and consequently by expansion of the air in the receiver, or by a small pump and metal pipe. In feeding by descent, the alcohol flows from the receiver a slight distance above the boiler. For vaporizing the spirit in the boiler, it may be either heated by a permanent pilot-flame, or by one diverted from the main flame, or by this flame itself, or again by a metal rod. All these methods of heating have been exemplified in the various lamps exhibited. The volatilized alcohol, under pressure in the boiler, is impelled by an injector into a bunsen burner, drawing along with it the air necessary for its combustion; and it burns with a very hot flame, which is transformed by a Welsbach mantle into an illuminating flame.

We shall have occasion, in a subsequent issue, to notice the principal varieties of lamps shown at the exhibition, which was very well attended, and was honoured by the presence of M. Loubet the day after his return from Russia. It has greatly advanced the cause of industrial alcohol consumption in France.

PERSONAL.

The resignation is announced of Mr. F. KNEEL, the Superintendent of the Exeter Water-Works. Mr. Kneel served the Water Company for five years prior to the purchase of the undertaking; and he has been in the employ of the Council for about a quarter of a century. His son (Mr. Alexander Kneel) has been employed under his father for the last fifteen years, and has had charge of the works in connection with the recent extensions at Pynes, including the necessary relaying of mains in the city. The Committee have therefore appointed him to succeed his father as Superintendent.

Mr. A. B. TOBEY, who is taking up the position of Manager of the Durham Gas-Works, was last Tuesday presented with a handsome smokers' cabinet by the staff and employees of the Scarborough Gas-Works, of which he has been Assistant Manager. Mr. A. Allan, the General Manager, who presided at the function, spoke of the efficient manner in which Mr. Tobey had fulfilled his duties; and Mr. Watson, the Works Foreman, in making the presentation, bore testimony to the good feeling which had always existed between Mr. Tobey and the men, and tendered their best wishes for his success in his new sphere of duty at Durham.

Blast Furnaces in the United States.—The productive capacity of the furnaces in blast in the United States at the commencement of May last was 352,064 tons per week, as compared with 337,424 tons, 323,028 tons, 332,045 tons, and 298,460 tons respectively at the beginning of each of the previous four months.

Manchester and District Junior Gas Association.—Arrangements have been made for holding the next meeting of the Association on the 21st inst., when a visit will be paid to the Leigh (Lancs.) Gas-Works, on the invitation of Mr. John Foster, the Engineer and Manager. As some important extensions have recently been carried out to bring the works up to date, the visit will afford special facilities to the members for enlarging their knowledge; and it is to be hoped that a large number will avail themselves of the privilege Mr. Foster extends to them.

Specific Heats of Gases at High Temperatures.—It is reported in the "Journal of the Association of German Engineers" that Herr Paul Winand, of Charkow, has proposed that determinations should be made of the specific heats of motor gases at high temperatures, in order to secure a trustworthy basis for calculating the duty of gas-engines. The Council of the Association of German Engineers had, in October, 1900, asked the Imperial Physical and Technical Institute to take up this work again in continuation of what had been done in 1894, because of its special importance; but they had received no answer up to the present. It is thought that such purely physical work is not a matter for engineering laboratories, but rather belongs to the scope of the German Imperial Institute; and a further application is to be made for its inclusion in the plan of work there.

REGISTER OF PATENTS.

Gas Purifying Apparatus.—Chandler, S. S. & S. B., of Brixton, S.W. No. 11,825; June 10, 1901.

This apparatus consists of a gas-tight chamber divided into upper and lower compartments by a horizontal partition or plate, provided with a number of holes through which what the patentees term "screens" or "tar-extracting pots" are passed—each screen or pot consisting of a pipe open top and bottom, the top end being formed with a flange of larger diameter than the holes in the partition plate, and serving to suspend the pot from the partition plate. The lower end of each pot is perforated; and the perforated portion is immersed in the liquor in the lower compartment of the chamber.

Fig. 1 is a longitudinal section of the apparatus. Fig. 2 is a transverse section. Fig. 3 is a plan of a portion of the apparatus showing a cover removed. Fig. 4 is a section (drawn to a larger scale) and a plan of one of the screens or tar-extracting pots.

The gas-tight chamber shown is divided by the horizontal partition

Fig.1

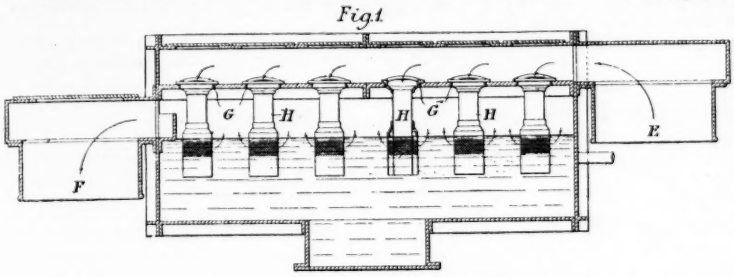


Fig.2.

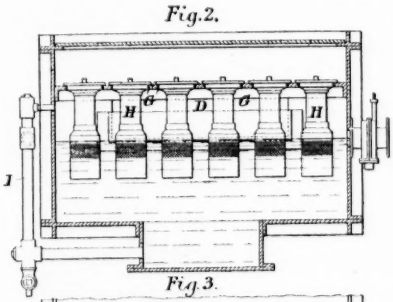
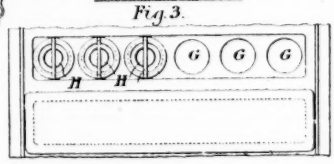


Fig.3.



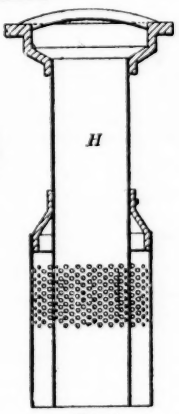


Fig.4.

into an upper and a lower compartment. The gas-inlet opens into the upper compartment E, and the outlet F for the purified gas extends from the lower compartment. The holes G, formed in the partition, are filled by the screens or tar-pots H, provided at their upper parts with flanges, by means of which they are supported upon the horizontal plate. The lower ends of the pots are provided with perforations, and are also enclosed in a jacket having perforations opposite to the perforations in each tube or pot. The tubes are open at top and bottom as described; and the jacket is open at the bottom also, but closed at the top. Liquor supplied to the lower compartment of the tank is maintained at the level indicated—that is, at a height in the tank which covers the perforations in the pots. There are manholes in the covers immediately above each of the tar-pots. I is the usual syphon device in connection with the tank, by means of which the accumulated tar can be discharged.

The gas enters the upper compartment through the inlet E, and passes down each of the tar-pots H, escaping through the perforations in it and the jacket into the water, and thence into the upper part of the lower compartment above the level of the water; "its passage through the water having washed it, and the tar being deposited."

Manufacture of Coal Gas.—Godwin, A. H., Keil, F. A., and Dougall, J., of Margate. No. 4901; Feb. 26, 1902.

This invention relates to improvements in the manufacture of coal gas by the destructive distillation of coal; the object being "to obtain a higher percentage of useful burning or illuminating gas from a given quantity of coal than is obtained by the ordinary process of carbonization, to practically prevent the formation of tar and naphthalene, and to also prevent the choking of all pipes from the mouthpiece into the hydraulic main."

The invention (in the words of the patentees, who do not illustrate the arrangement they propose), consists essentially in injecting highly superheated steam into the mouthpiece or ascension-pipe, so as to meet the gases rising to the ascension-pipe. The steam is generated and heated to the required degree, to produce highly superheated steam, in any convenient and suitable manner, and led into the mouthpiece or ascension-pipe (preferably at the base) by supply-pipes conveniently arranged to allow of it meeting the rising gases; while valves fitted to the supply-pipes limit the amount of steam admitted, which must vary according to the volume of gas evolved from the coal at different periods of firing, or allow of it being cut off entirely when it cannot be further usefully employed.

Internal Combustion Motors.—Dunlop, J., of Manchester. No. 13,578 July 3, 1901.

This invention relates to internal combustion motors operating on the well-known four-stroke compression cycle, and in which governing is effected by varying the amount of combustible mixture shut into the cylinder for compression; the object being to provide valve-operating mechanism for the admission and ignition valves which will suitably vary the movements of the valves according to the load on the motor, and at the same time permit of them being easily controlled by the governor. The mechanism may be arranged to close the admission-valves at different periods of the charging stroke, and so vary the amount of combustible mixture drawn into the cylinder; or it may be arranged to keep the admission-valve open during the whole of the charging stroke, and close it at different periods of the compression stroke, so as to vary the amount of combustible mixture admitted to the cylinder for compression. This latter is the preferable arrangement, says the patentee, as it leaves the greatest time interval between one impulse and the instant the governor decides the power of the next impulse.

The improvements consist of an eccentric fixed on the valve-operating shaft and fitted with an eccentric strap having a projection on it, the surface of which is concentric with the centre of the eccentric. This projection extends beyond the normal surface of the eccentric strap an amount greater than the lift of the valve to be operated. The eccentric strap is linked to the governor in such a manner that, as the governor rises and falls, the eccentric strap will be moved around the eccentric in opposite directions. Within range of the projection on the eccentric strap, is placed a roller on the valve-rod or lever to be operated. As the projection on the eccentric strap is concentric with the centre of the eccentric, the period at which the projection comes in contact with the roller will be a constant one. But, owing to the rise and fall of the governor moving the eccentric strap around the eccentric in opposite directions, the period at which the projection comes out of contact with the roller will be a variable one. By this means, the movements of the admission-valve will be varied according to the load on the motor. To vary the movements of the ignition-valve, a similar construction of mechanism to that just described may be used; but it is preferable to arrange the position of the ignition-valve roller so that it is within range of a second projection on the eccentric strap that operates the admission-valve, so that one piece of mechanism serves both purposes.

Lighting Street Gas-Lamps.—Rigaux, H., of Brussels. No. 13,651; July 4, 1901.

This invention relates to a lighting device for street and similar lanterns, by which the main burner is lit through the medium of an auxiliary burner placed above the flame, and on the outside of the frame of the lantern; the burner being lit by means of a travelling ignition, and which has the gas admitted through an automatically closing valve, opened by the lighting torch and closed on the withdrawal of the torch by its own weight and a spring—the torch coming into close vicinity to the first flame-holes of the ignition-tube, and lighting same.

An illustration is given of the lighting device attached to a street-lantern during the act of lighting same; also an enlarged vertical section and plan of the auxiliary burner.

The branch-pipe B enters and terminates in a valve-case F, the valve A of which is kept closed by the spring C. It has attached to it, at its lower end, a pendant rod E, which passes through a stuffing-box

Fig.1.

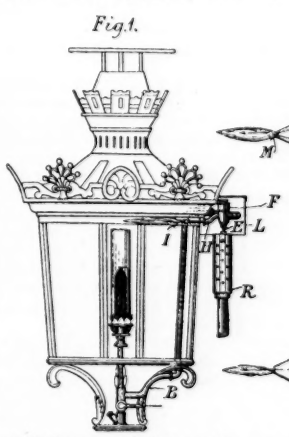


Fig.2.

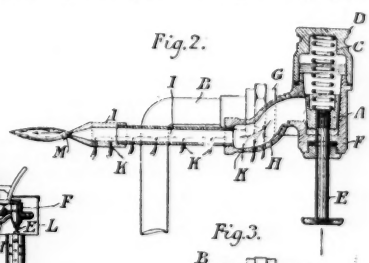
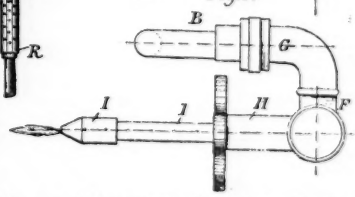


Fig.3.



at the lower end of the valve-case to keep it tightly closed. As shown in fig. 3, the valve-case F is connected with the branch-tube B by a coupling elbow-pipe G, and from the valve-case branches off a flash-tube H, the first flame-holes K of which are close to the valve-rod E. To the other end of the flash-tube, there is attached the nozzle I, which forms the auxiliary burner, and which may have outlets arranged in such a manner that the lighting flames project from them in any direction required for lighting several gas-flames simultaneously required. The lighting device is protected against wind and rain by a cover L.

To light the lantern, the tap of the main burner is opened; then the valve-rod E is pressed upwards; and the valve A is opened by the lighting-torch R. The gas passes then at once through the branch-tube B and the elbow G, to the flash-tube H, and escapes, through the first openings K, in a downward direction. The nearest jets of gas are at once ignited at this place; and then all the others along

the flash-tube also ignite in the usual manner. During the process of lighting, the valve is kept open by the pressure of the lighting-torch on the rod E. When the main burner is lit and the lighting-torch withdrawn, the valve A is closed by its own weight and by the pressure of the spring C, and the lighting jets are extinguished.

Raising and Forcing Liquids in Ammonia Stills, &c.—Wilton, J., of Beckton, E. No. 5422; March 14, 1902.

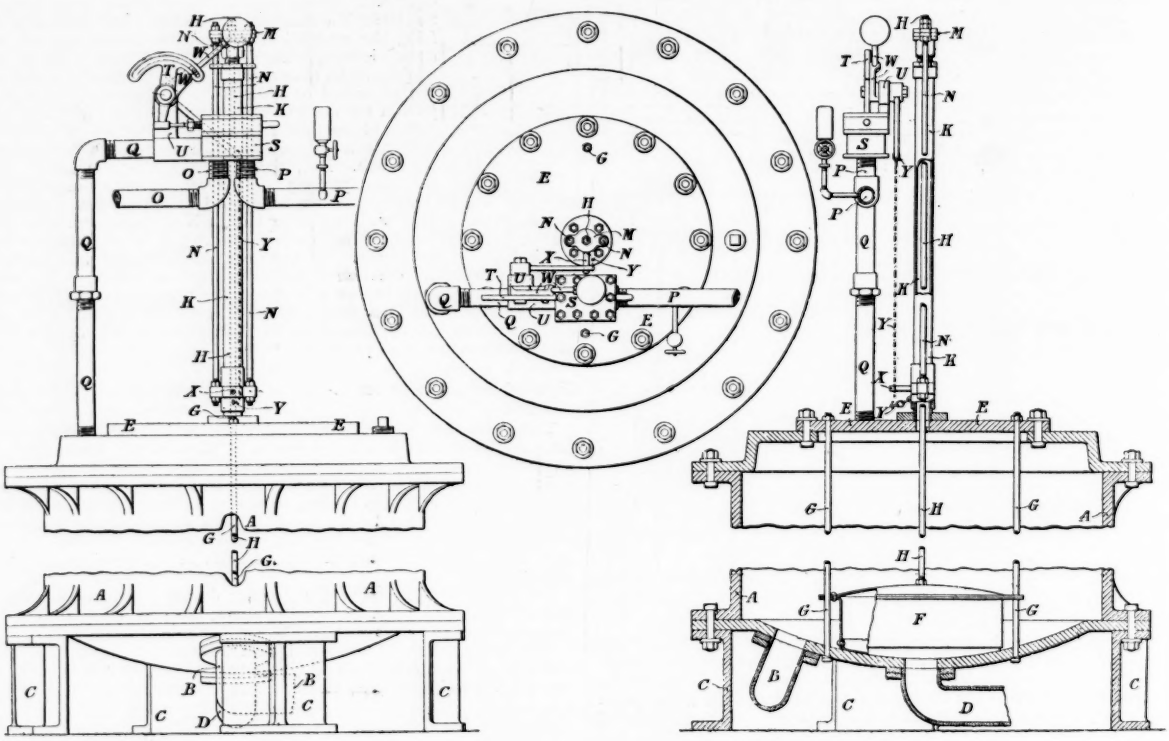
This invention relates to apparatus for raising and forcing liquids—especially liquids such as gas liquor, acids, milk of lime, &c., used in the manufacture of gas.

In apparatus of this kind hitherto made (the patentee points out), the working parts have been more or less enclosed or exposed to the deleterious action of the liquids dealt with, or the apparatus has had to be so delicately adjusted for working that stoppage and incomplete discharges frequently occur, and also it has been found necessary to adjust the apparatus for the particular kind of liquid to be raised. It is the object of the present invention "to provide a simple, strong, and efficient apparatus not liable to get out of order, and wherein all parts are readily accessible for cleaning, and where the working parts are mainly exposed to view and disposed in such position as to be free from the detrimental action of the liquids treated or the vapours therefrom."

The accompanying engraving shows a front elevation (broken) of the apparatus, a plan, and a sectional side view.

The chamber in which the liquid to be raised flows under a suitable head of pressure is provided with an inlet-pipe B fitted with a non-return valve (not shown). The chamber is formed of a cylindrical part A secured by flanges and bolts to a base-plate supported upon suitable feet C. D is the discharge-pipe from the chamber communicating with the still or other apparatus to which the liquid is to be delivered. The cover is formed with a central aperture closed by a plate E, which supports the working parts of the apparatus. F is a float adapted to rise and fall with the level of the liquid in the chamber, and is mounted in guides G, the upper ends of which are passed through, and bolted to, the plate E; while the lower ends are secured to the base. A rod H passes up from the float through the chamber and through a tubular extension K mounted on the cover-plate E. This tubular part is open at its lower end to the chamber, and is provided at its upper end with a stuffing-box through which the rod H passes. M is a cross-head mounted on the outer end of the rod H, and having guide-rods N connected to another cross-head adapted to slide upon the exterior of the tubular part K. A slide-valve is adapted to open or close the steam-pipe O and exhaust-pipe P to the upper part of the chamber by a steam-pipe Q.

The slide-valve is of ordinary construction, and is enclosed in a casing S supported upon the steam-pipe. The spindle of the slide-



valve is actuated from the end of a quadrant lever T centred upon a bracket U, also carried by the steam-pipe Q. The upper end of the lever has a curved or quadrant-shaped slot, in which slides freely a pin or projection upon a weighted lever W. This lever is centred upon the same pin as the quadrant, and is of bell-crank form—having an arm projecting at such an angle and in such a position as to be engaged by a finger X upon the cross-head when the latter arrives at the end of its stroke on the rising of the float in the chamber. The finger causes the weighted lever to be moved beyond the vertical line of its centreing point; and the weight then acting sharply upon the end of the slot, moves the lever T to open the slide-valve. A chain Y connects the arm to the cross-bar, so that the weighted lever is again tipped over its centre to actuate the slide and close the steam admission when the float and cross-bar move to the other end of its stroke.

When in operation, the liquor is fed to the chamber through the pipe B under a suitable head. As it fills the chamber, the liquor raises the float, and, through the rod H, raises the cross-head until the finger X engages the arm and trips the weighted lever W and operates the slide-valve. Steam then passes by the pipe Q to the chamber, and drives out the liquor therefrom through the discharge-pipe D. When the discharge is complete (or nearly so), the chain Y tightens and pulls upon the arm so as to tip the weighted lever back to its vertical position, and so—by the slide-valve closing the steam admission and opening the exhaust, and the pressure in the chamber being reduced—the liquid again flows in, and the action automatically continues.

By mounting the whole of the working parts connected with the float independently of the steam-valve mechanism upon a covering plate E, the whole of the parts can be detached for cleaning or otherwise without disturbing the steam connection—the chain Y only being disconnected. The aperture covered by the plate E is also of such dimensions as will allow the float to be readily removed, which can be freely accomplished as the upper ends of the guide-rods are disconnected in the act of removing the cover. The parts of the apparatus are by their position exposed as little as possible to the action of the corrosive or other liquids operated upon.

APPLICATIONS FOR LETTERS PATENT.

13,302B.—Naef, P., "Utilization of heat from furnaces, gas-engines, and air-compressors." June 2.

12,482.—Beal, W., "Holders for shades and chimneys of incandescent gas-lights." June 2.

12,490.—Park, J., "Gas-generators." June 2.

12,509.—Wood, J., and Smith, A. E., "Controlling gas-lights." June 2.

12,513.—Galopin, H., "Measuring the flow of fluids." June 2.

12,515.—Chandler, J. & S., "Bearings for rotary gas washer-scrubbers." June 2.

12,552.—Settle, T., and Padfield, W. A., "Manufacture of coal gas." June 2.

12,682.—Edgar, W., "Street-lanterns." June 3.

12,710.—Loeben, G. A., "Mixing air and gas." June 3.

12,715.—Lanchester, F. W., "Gas and oil engines." June 4.

12,745.—Graham, M., "Coal-stops for inclined retorts." June 4.

12,746.—Herring, W. R., "Discharging inclined retorts." June 4.

12,747.—Herring, W. R., "Charging inclined retorts." June 4.

12,781.—Chandler, S. & J., "Treating gas with regard to naphthalene at an early stage." June 4.

12,806.—Batchelor, J. G. H., "Internal combustion engines." June 5.

12,829.—Ross, J. H., "Acetylene gas-generators." June 5.

12,847.—Lanchester, F. W., "Gas and oil motor-engines." June 5.

12,878.—Haddan, R., "Incandescent burners." A communication from the Aktien Gesellschaft fur Fabrikation von Broncewaaren und Zinkguss, vormals J. C. Spinn and Sohn. June 5.

12,918.—Young, W., and Glover, S. & T., "Economical gasification of bituminous coal, slack, or other fuel." June 6.

12,933.—Krefft, W., "Gas boiling-stoves." June 6.

12,955.—Junkers, H., "A suspended gas heating-stove." June 6.

13,007.—Davis, H. N., "Gas cooking-grillers." June 7.

13,021.—Crossgrove, T. A., "Engine or motor actuated by fluid under pressure." June 7.

CORRESPONDENCE.

[We are not responsible for opinions expressed by correspondents.]

The Condensation of Coal Gas.

SIR,—I am much obliged to Mr. Botley for calling attention to Mr. John Somerville's *brochure* on "Hot Frictional Condensation," which I had not previously seen. In addition to this proposal, and that of St. John, other methods of removing the heavy tar-fog from the hot gas were suggested in the early eighties ("JOURNAL," Vol. XXXVII., p. 837, and Vol. XXXIX., p. 1196); but no account of the results obtained appears to have been published since 1884.

The fact mentioned by Mr. Botley—that the baffles proposed by Mr. Somerville were tried without success at Hastings—does not prove that the removal of the heavy tars previous to condensation is of no benefit. It simply shows that this is not, by itself, capable, under the Hastings conditions, of effecting the sufficient elimination of the naphthalene. This portion of the process is only a preliminary one; being carried out with the object of rendering the light oils which subsequently separate capable of dissolving larger quantities of naphthalene. The most essential point is the carrying forward of the light oils with the gas until it is completely cooled; and unless this is done, the preliminary removal of the heavy tar-fog will only have a small effect.

I am quite unable to agree with Mr. Botley that no advantage is likely to be obtained by a study of the conditions under which condensation takes place in different works. It is well known that two works, with the same general conditions as to the kind of coal used and methods of carbonization and condensation, may have a totally different experience with regard to naphthalene; the one suffering greatly, while the other is quite free from the trouble. This indicates that in the latter works certain conditions chance to exist which are favourable to the removal of naphthalene, but which are not readily apparent. Very careful comparison of the plant, &c., in each works should lead to the detection of the favourable conditions; and these, once recognized, can be reproduced designedly at other works. The difficulties of such an investigation are undoubtedly great; but I am not yet prepared to acknowledge them as "illimitable."

HAROLD G. COLMAN.

Saltley Gas-Works, Birmingham,
June 12, 1902.

Tapers and Inclined Retorts at Mariendorf (Berlin).

SIR,—From the remarks made in your "Editorial Note" on my article on "Retort-Houses for Inclined Retort Settings," in the "JOURNAL" for the 3rd inst., I find that I have not made clear the actual size of the inclined retorts at Mariendorf. These all taper towards the bottom by 2¼ inches; the section given in the article (21in. by 15in.) being that at the middle part of the retort. The retorts set in 1892 in Vienna were tapered, and the advantages shown were so great that up to the present time only tapered retorts have been set.

E. DRORY.

Berlin, June 7, 1902.

The Price of Gas at St. Helens.

SIR,—I see by the last number of the "JOURNAL" that you notice the past year's working of the St. Helens Corporation Gas-Works, in which you give many of the interesting figures contained in the Chairman's recent speech at the Council meeting, taken from a local contemporary. It has occurred to me that it might be interesting to some if the price at which we have been selling had been stated, and from which we are intending to take 3d. off all round.

Our nominal price was 2s. 6d. per 1000 cubic feet for lighting and heating purposes, with a discount varying from 12½ to 5 per cent., according to the amount of the annual consumption, as follows: 5 per cent. off consumers using from 20,000 to 50,000 cubic feet, 7½ per cent. off 50,000 to 100,000 cubic feet, 10 per cent. off 100,000 to 1,000,000 cubic feet, and 12½ per cent. off 1,000,000 cubic feet and upwards. These discounts are taken off the account for the March quarter, after the four quarters have been completed. For gas-engines, we had made a special rate of 2s. per 1000 cubic feet, less 2½ per cent. for monthly payments, as I have the accounts for the gas consumed in gas-engines delivered monthly—a system which I find suits very well the firms who use them.

It is from these prices that the 3d. per 1000 cubic feet is to come off, and the prepayment consumers are to have their quantity increased from 30 to 33 cubic feet per penny; making a nominal difference of only 3d. per 1000 cubic feet between the so-called "ordinary" consumers, which are really very often six months' credit consumers. In addition to the above, our consumers have the advantage of not paying meter-rents, which is equal to 1d. per 1000 cubic feet, and no stove-rents, which is equal, on an average, to about 1½d. per 1000 feet. All meters and services are fixed free, and also stoves, so far as labour is concerned, and only cost price is charged for material.

Our gas is purified most thoroughly, and is, on an average, of 18½ candles illuminating power; so you will see from this that we are doing something to supply our townspeople with cheap and good gas for lighting, heating, and power.

SAMUEL GLOVER.

St. Helens, June 13, 1902.

Begging for the Beanfeast.

Under this heading, a paragraph appeared in our "Editorial Notes" on the 27th ult., in which attention was called to the highly objectionable practice, now prevailing to a certain extent, of sending out applications for funds towards defraying the cost of workmen's annual excursions, &c. We have recently received several letters from firms who have been troubled in this way; but perhaps the most noticeable of these is a communication from a correspondent, who remarks: "We read your condemnation of the principle which obtains in some corporation gas-works of allowing workmen to use the corporation paper, in all its beauty, with the coat of arms, &c., to send out begging letters. Enclosed you will find a sample of this class of thing, which, in the interest of all parties, should be stamped out." The letter enclosed comes from a pretty considerable town in Lancashire, and is as follows: "We beg respectfully to inform you that our nineteenth annual workmen's trip takes place at an early date, and the place selected is ———. They will be pleased to receive, through the Engineer and Manager [name given], or the undersigned, any contribution you may be disposed to send towards making the outing an enjoyable one. Signed on behalf of the workmen, &c." This is, if anything, a worse example of the practice than that which originally called forth our condemnation of such begging letters.

A Query as to Water Supply.—A correspondent asks for particulars in regard to the following case, which he thinks arose somewhere in the Midlands: A water company (A) had the right to supply a district, a portion of which they were unable or unwilling to supply. A neighbouring company (B) offered to supply, but had no legal power. A objected. Did B overcome A, and ultimately supply this portion of the district?

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bill brought from the Commons, read the first time, and referred to the Examiners: Liverpool Corporation Bill.

Bills read a second time and committed: Bournemouth Gas and Water Bill, Leamington Corporation Bill, West Gloucestershire Water Bill.

Bills reported: Abercarn Urban District Gas Bill, Bedford Corporation Water Bill, Belfast Corporation Bill, Birkenhead Corporation Bill, Broadstairs Gas Bill, Halifax Corporation Bill, Huddersfield Corporation Bill, South Metropolitan Gas Bill.

Bills read the third time and passed: Abercarn Urban District Gas Bill, Consett Water Bill, Devonport Corporation (Water) Bill, Gas Orders Confirmation Bill (No. 1), Leyland and Farington Gas Bill, Menai Bridge Urban District Council Bill, Nottingham Corporation Bill, Whitstable Improvement Bill.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bills brought from the Lords, read the first time, and referred to the Examiners: Consett Water Bill, Devonport Corporation (Water) Bill, Gas Orders Confirmation Bill (No. 1).

Lords' Bills reported: Bristol Water Bill, Buxton Urban District Council Bill, Longwood Gas Bill, Rickmansworth Gas Bill.

Bills read the third time and passed: Abertillery Urban District Council Bills [Lords], Bradford-on-Avon Gas Bill [Lords], Coatbridge Gas Order Confirmation Bill [Lords], Liverpool Corporation Bill, Newcastle and Gateshead Water Bill [Lords], Swansea Corporation Water Bill [Lords], Swindon United Gas Bill [Lords].

HOUSE OF COMMONS COMMITTEE.

Tuesday, June 10.

(*Before Sir* J. BRUNNER, *Chairman*, *Mr.* COGHILL, *Mr.* BOLAND, *Mr.* ORMSBY-GORE.)

RICKMANSWORTH GAS BILL.

This was an application for further capital and additional powers, including the reconstruction of the Company and the works.

Mr. WEDDERBURN, K.C., and Mr. KEEN represented the promoters while Lord ROBERT CECIL, K.C., and Mr. C. HUTCHINSON appeared for the Rickmansworth Urban District Council—the sole petitioners against the measure.

Mr. WEDDERBURN, in opening, said the Company was originally incorporated in 1852 as a limited liability Company; and in 1885 they obtained, under the Gas and Water Facilities Act, a Provisional Order, and thus became a *quasi*-statutory Company. In 1885, their capital consisted of £10,733 of original 10 per cent. stock; and in that year they obtained £5000 further capital, at 7 per cent. All this had been issued except £233; so that the capital totalled £15,500, beyond which there was a mortgage debt of £3933. The sole opposition was that of the Rickmansworth Urban District Council, the most populous district in the whole area, though Chorleywood was rapidly growing. At a meeting on Feb. 21, the Chairman of the Urban District Council said that the sole object of the opposition was to see if they could not get a reduction in the price of gas. The Council then proceeded to oppose the Bill without complying with the Borough Funds Act, with the result that the Company went before Mr. Justice Kekewich and obtained an injunction restraining the Council from spending the ratepayers' money in opposing the Bill. This was just before the measure went into Committee in the House of Lords; but the Council did not withdraw their appearance till the very last moment, thus putting the Company to some considerable expense. The Council then called meetings of the Council and of the ratepayers with a view to opposing the Bill; but even in this they acted irregularly, because, instead of holding the Council meeting first and the ratepayers' meeting afterwards, they reversed the order. Before the ratepayers' meeting, however, the Council issued a circular, which was so misleading in its statements as to the Company that it might become a question as to what value was to be attached to action founded upon it. The first object of

the Bill was to reincorporate the Company. Then it was sought to convert the £10,500 of 10 per cent. capital into £21,000 of 5 per cent. capital, and the £5000 of 7 per cent. into £7000 of 5 per cent. capital. Such an action was constantly done for the convenience of a company. It would not in any way affect the consumers; and the sole result would be to make the shares more easy to dispose of on the market. There would thus be £28,000 of converted capital, upon which the dividend payable would be exactly the same as that payable on the existing capital. In addition, further power as to £47,000 (making £75,000 in all) was asked, with the usual borrowing powers of one-third. In regard to this, the whole question to be considered was as to how long the fresh capital would last. It was proposed to extend the area of supply by taking in the small parish of Chenies, which was adjacent to Chorleywood and in the county of Buckinghamshire. There were people in this village who would find it advantageous to use gas. The Duke of Bedford had endeavoured to oppose this part of the Bill; but his *locus standi* was disallowed by the Court of Referees. This extension was now unopposed except by the Rickmansworth Council, who urged that if the Company were to give a supply to Chenies they would have to lay unproductive mains, with the result that the money thus spent would prevent the cheapening of gas. The answer to this was that the Company would not lay unproductive mains, and that the extension to Chenies would only be made if there was sufficient demand for gas there to make it worth while to do so. He should ask the Committee not to hear the Rickmansworth Council on this point. It would be a monstrous thing if, supposing the Company could lay productive mains to Chenies, the Rickmansworth Council should have power to step in and prevent them. The local Council also raised a point as to the standard price of the Company, which had been fixed by Parliament, and upon the maintenance of which the original subscribers had found the capital of the Company. There was no instance of an alteration of the standard price by Parliament, except the Lea Bridge case, which was usually quoted as one which had better not have occurred; and he did not suppose there was the least hope that the Committee would, in compliance with the request of the petitioners, alter the standard price here. At present, it was 4s. 7d. per 1000 cubic feet; and the Council asked that it should be reduced to 3s. 9d. The standard price was usually fixed in relation to the actual price being charged; and there was generally a margin between the standard and the actual price. In this case, the standard was fixed in 1885 at 4s. 7d., and the actual price charged for gas was 4s. 6d.; so that there was practically no margin. It was said that the price charged by the Company was high; but the price compared with figures of 5s. in Hoddesdon and Uxbridge, and 7s. in Pinner. In other places the margin was far larger; the figures at Watford being 4s. 3d. and 3s., and at Chesham 4s. 9d. and from 3s. 10d. to 4s. 2d. As there was only a penny difference between the standard and actual price in the present case, it was difficult to see how the Committee could reduce the standard. In the circular which emanated from the Clerk to the Council, it was stated that the arrangement proposed with regard to the sliding-scale was so ingenious that it was difficult to explain it correctly. It was not, however, in the least difficult to explain. At present, with a maximum dividend of 10 per cent., for every penny change in the price of gas, the Company were entitled to divide 5s. per cent., more or less. Instead of £10 shares at 10 per cent., there would be two £10 shares at 5 per cent., and the 5s. would be reduced to 2s. 6d. The only other power sought was as to the supply of gas for power purposes. Rickmansworth was not an industrial neighbourhood; and this proposal was made, not because they wanted to introduce power gas, but because they wished to protect their position in the future. Counsel then referred at length to the petition of the Council. They admitted that the demand for gas in their district was increasing; but they said that the power to raise any new capital required to enable the undertaking of the Company to provide for such increase, should be obtained by an application to the Board of Trade for a Provisional Order under the Gas and Water Facilities Acts. The petitioners denied that a capital of £100,000 (including borrowing powers) was required, or that the Company should be dissolved and reincorporated with further powers. With regard to the capital, Counsel pointed out that it had now been reduced to £75,000. The petitioners also objected to the inclusion in the limits of supply of the parish of Chenies, alleging that it did not naturally come within the district of the Company, and that it was outside the county of Hertford, which, in the event of the Council taking over the undertaking of the Company, might lead to inconvenience. As to this, Counsel stated that neither the Parish or Rural District Council of Chenies had objected to the proposal; and the assumption, therefore, was that Chenies desired to have the opportunity to take gas from the Company. Why then should the Rickmansworth Council act like the "dog in the manger?" The Council also declared that the extension of the Company's mains to Chenies would prevent them from carrying on their business in an economical manner, and would require the fixing of the standard price of gas at an excessively high figure, to the injury of the inhabitants of Rickmansworth. They said the incorporation of the new Company as proposed by the Bill had many objectionable features, particularly relating to the manufacture and supply of power gas, capital, and limitation of profits. The petition continued:

> The provisions of clause 21, which determine the conditions upon which the shares in the capital of the old Company are to be exchanged for ordinary stock of the new Company, are extravagant, and cannot be justified by past experience or reasonable expectations of the future. This is the more important because, as your petitioners believe, a considerable portion of the original capital of the Company was never actually fully subscribed or paid up, and the proceeds never expended upon works the cost of which would probably have been charged against capital. The provisions of the Bill relating to the limitation of profits, having regard to the standard price proposed to be fixed, are, your petitioners allege, inadequate for the protection of the public, and should not be allowed to pass into law.

They denied that the Company could make and supply power gas at a profit, and believed the only result of conferring authority as to power gas would be to prevent the introduction of power gas into the district upon a proper commercial basis. Counsel informed the Committee, however, that this clause was taken from the Caterham Gas Bill of this year—the most recent precedent. The Council contended that the provisions of the General Acts for the protection of road and local authorities were insufficient, and that no adequate protection was provided for the Local Authority. As to this, Counsel said they had the protection of the general law, and the Committee could hardly go into the question of whether that was sufficient or not. The Council then alleged that the protection afforded to the consumers and interests of the inhabitants of the urban district of Rickmansworth were inadequate; that the standard price of 4s. 7d. was excessive; that it was unfair to fix the same standard price for both the urban district and rural parishes; and that no sufficient provisions were made as to the supply of power gas in respect of quality, price, or obligation to supply. Lastly, the Council said: "The Bill contains no clause conferring power upon the Rickmansworth District Council to purchase the undertaking, or such part thereof as is situate within the urban district at the date of purchase; and this Council contends that if the Bill be allowed to proceed, provisions should be inserted therein enabling them to purchase, and requiring the Company to sell its undertaking, or such part thereof as aforesaid, at any time after the passing of the Act, upon terms to be agreed or to be fixed by arbitration." This, however, was a matter altogether outside the purview of the Bill. If the Council desired to purchase, they must come with a substantive Bill, so that the Company might know what they had to meet. The distinction had always been drawn that a gas company was not liable to purchase by the local authority unless there was complaint against it; and surely the Committee would not go into complaints, if there were any, against the Company.

Mr. *R. W. Henderson*, Chairman of the Company, examined by Mr. KEEN, gave evidence in support of Counsel's opening statement. With regard to the capital, he explained that some £2000 was distributed among the existing shareholders just before the Provisional Order was obtained in 1885. This followed the making of a structural valuation, which showed that £2000 had been spent on the works more than the nominal capital expenditure. In the last few years, a further sum of £2080 had been spent out of revenue on capital purposes. With regard to the proposed inclusion of Chenies, he said it abutted on Chorleywood, which was extending very rapidly. He had heard of no objection to the proposal; and, as far as he could see, no harm could arise from it. The capital originally proposed was £100,000; but it had now been reduced to £75,000, £28,000 of which would be original capital, and the remaining £47,000 additional capital. The standard price in the Bill was the same as that at present existing; and it compared very well with the standard price in other districts of a similar kind and similarly situated to Rickmansworth. It would be a serious thing for the original shareholders, and those who had since bought shares, if the standard price were reduced. Apart from the meeting of ratepayers under the Borough Funds Act, he had heard of no indication of opinion by the ratepayers on the question of purchase of the Company's concern; and owing to large expenditure which the Council were undertaking on a sewerage system, he thought it unlikely they would want to undertake further outlay. It was unfair that the Company should be saddled with any puchase of the kind suggested. If the Council desired to purchase, they should promote a Bill.

The witness was then taken at length through the various statements in a circular to the "Owners and ratepayers of the urban district of Rickmansworth," which had been circulated broadcast, and in which a public meeting was announced for Monday, May 5, when it was hoped the reader would attend and support the Council in the course they might feel it their duty to take with regard to the Bill. He declared that a number of these statements were misleading and inaccurate, though they were the chief grounds on which the ratepayers had voted at the meeting.

In cross-examination by Lord R. CECIL, witness said the Company started in 1852; and in 1884 their capital consisted of £4500.

Lord R. CECIL: On the 28th of March, 1884, before the Provisional Order of that year was granted, did you issue £4000 more?

Witness: Yes.

The CHAIRMAN: How did they do that?

Lord R. CECIL: I think there is no doubt about the fact. I think they must have done it in excess of their powers.

Mr. WEDDERBURN said that section 6 of the Rickmansworth Gas Order recited that the capital of the Company consisted of £10,700, which showed that Parliament had already accepted the transaction about which Lord Robert was cross-examining witness.

Lord R. CECIL said his point was to show that the capital expended on the works of the Company in the last fifty years amounted to £8500, or something of that kind, and therefore that the capital powers now sought were out of all reason.

In further cross-examination, witness said this £4000 was allotted among the shareholders at par, and subsequently, on a valuation of the works, £2000 more was allotted to the original shareholders. By the Provisional Order, £10,500 was recognized as the capital of the Company, and £5000 additional was allowed. Assuming that it was right to take off the £2000 allotted to the shareholders, all the capital raised would be £13,500. It was proposed to convert this into capital of the nominal value of £28,000. He did not agree that if the capital were converted, and the shares then bore a dividend of 3½ per cent. instead of 6⅔ as at present, they would be less saleable. It did not appear to him that if the capital were converted and made of the nominal value of £28,000 there would be an increase of the borrowing powers of the Company. The mortgage debt of the Company had been advanced by witness. Asked whether there was any limit in the Bill on the interest payable on borrowed capital, witness said they had never paid more than 4 per cent.

Mr. WEDDERBURN: We do not object to a limitation.

In further cross-examination, witness said at present the Company's mains were probably not more than 2 miles from the Chenies district, which was very sparsely populated. It contained eighty houses, and a population of about 300. The Chenies Council, on June 2, since this Bill had been committed to the present Committee, had passed a resolution strongly opposing the proposal to supply their district. The Duke of Bedford, the largest landowner in that area, was also opposed to it. The reach Chenies, nearly 3 miles of mains would have to be laid; but they would not be unproductive.

The CHAIRMAN: I think it will save time if I give an intimation to

Mr. Wedderburn that it will probably facilitate his course if he drops Chenies.

Further cross-examined: Authority to sell gas for power was sought in case it was required in future. The district was not industrial. No estimate had been made of the capital which would be required for this purpose. If the Company only progressed at the same rate as in the past, the capital sought would last fifty or sixty years. He would not say it was unfair that the Company should be purchased if the price were fair. He had no objection to the Council buying the whole of the undertaking; but there certainly was an objection to them purchasing a part only.

Mr. WEDDERBURN (in re-examination): Do you, on behalf of the Company, object to any clause in this Bill by which the Council would have the perpetual right, which they might hold over your heads for all time, to purchase your undertaking?

Witness: Yes.

Wednesday, June 11.

On the resumption of the proceedings to-day,

Mr. *Henderson* was re-called. Witness said he was present at a conference between representatives of the Company and the Council. After all the details of the Bill had been gone through, Mr. Yorke, the Chairman of the Council, made a remark to the effect that the only point he really cared for was a reduction in the price. The representatives of the Company then conferred together, and afterwards informed the representatives of the Council that, if that was the only matter, they were prepared to consider it.

Mr. *William Keen*, examined by Mr. KEEN, said he had investigated the accounts of the Company, and produced a number of tables showing the results. He stated that the capital expenditure up to 1891 had been £12,862; and since then to the end of 1901, £22,060. In each case these figures included the £2000 to which reference had been made as being added on re-valuation in 1884. He looked into the matter of this £2000 to a limited extent only, starting with the information that a valuation had been made which showed that the works were worth £2000 more than they appeared to be. It seemed to him that this was the case; and he learned from the books that shares to the value of £2000 were duly issued to the shareholders. The account as to the money received as against the money expended on capital account, showed that the balance had been overspent year by year since 1889. In that year it was overspent by £317, and in 1901 the figure had risen to £2079. The capital raised amounted to £15,500, which, with premiums of £447 and the loan capital of £3933, made a total of £19,980. The capital expenditure to date was £22,060; so that there was an overpayment of £2079. The sale of gas in 1890 was 6,650,000 cubic feet, and in 1901 14,993,300 cubic feet—an increase of 8,337,900 cubic feet, or about 125 per cent. From 1897 to 1901, the dividend paid had been at the rate of 6¾ per cent. on the 10 per cent. capital, and 4⅜ per cent. on the 7 per cent. capital.

In cross-examination by Mr. HUTCHINSON, witness said it was of considerable value to the consumer to have the capital of the Company adjusted on such terms that the premium given for the shares should be as high as possible, because the premium went into the concern and bore no dividend. The consolidation in this case would increase the prospects of premium. In the last four years, the increase in gas sold had been at the rate of 7 per cent. per annum. The dividends of 6¾ per cent. and 4⅜ per cent. on the 10 and 7 per cent. shares respectively had been paid for five years. For the three years before that, the dividends were 5 5/16 and 4 1/12 per cent. He did not know that in 1884 and previously the Company paid dividends of 10 per cent. The effect of adding £2000 nominally, in the shape of bonus shares, to the capital, would be to reduce the dividend. But there were other considerations in connection with this matter, such as the price of coal, consumption of gas, &c.

Mr. HUTCHINSON: Suppose a gas company paying 10 per cent. dividend go to the Board of Trade to fix a standard scale. One scale would be fixed?

Witness: Yes.

Suppose the same company were to go to the Board of Trade and say they were only paying 6¾ per cent.?—That would be a material consideration, no doubt.

Mr. WEDDERBURN: In the Act of 1885, that transaction is accepted. One cannot go behind it.

In further cross-examination, witness said last year the revenue from slot meters was £1016; the gas sold by slot meters in the year being 4,393,900 cubic feet out of a total sale of 10,689,400 cubic feet.

In re-examination by Mr. WEDDERBURN, witness said it was no disadvantage to a consumer if a company made capital expenditure out of revenue. On the contrary, where it had been done shareholders might claim to be repaid not only their capital, but their interest on it. Here they only claimed to be repaid the amount of the capital. It was a common thing for a company to ask Parliament to sanction capital which they had overspent.

Mr. *Corbet Woodall*, examined by Mr. WEDDERBURN, said he had visited the works and district of supply of the Company. The district was residential; and it was now developing rapidly, owing to the extension of the District Railway there. In 1893, the amount of gas sold was 8,366,000 feet; in 1900 it was over 16,000,000 feet; and in 1901 there was a further slight increase, bringing it to nearly 17,000,000 cubic feet. Thus, between 1893 and 1901 (eight years), there was an increase of 102 per cent. The number of consumers had also largely increased; having been 216 in 1894, and 663 in 1901.

The CHAIRMAN: The whole of the increase due to prepayment meters came into that period?

Witness: Yes.

In further examination, witness said the average increase in the gas sold in the past eight years was 9·17 per cent. He allowed for an increase of 12 per cent. in future, having regard not only to the past increase, but to the development of the district now taking place. This meant that the output in fifteen years would be 93 million cubic feet. From the capital proposed in the Bill, £28,000 the amount of the converted capital, and £4000 borrowed money, had to be deducted, leaving the total additional capital as £68,067, which he did not think would be sufficient to last more than fifteen years. Calculating the growth in the Company's business at 12 per cent., there would be an increase in this period in the sale of 76 million cubic feet.

Mr. WEDDERBURN: What do you reckon for the future expenditure upon works?

Witness: That requires some explanation. Nearly £1300 per million cubic feet has in the past been spent on works; but I do not think in the future, although the expenditure will include that for prepayment supplies, it will exceed £700. In the early days of a company, the capital is necessarily high per unit of business done; but as the business increases, the proportion of capital to business ought to diminish. On an increase of 76 millions, £700 per million would represent £53,000. The capital is already overspent by £2080, and £4000 is required for working capital. In addition, the works are below the necessary standard for the business they are doing, and they want a further sum spent upon them immediately. Further, they are on the eve of supplying the Local Authority with gas for working pumping-engines for their sewerage works—flushing sewers, &c. This will make a greater call on the Company, owing to the arrangement made, and will involve the laying of larger mains. The capital to be spent in the next two or three years on extensions of mains and various plant at the works, I estimate at £12,000. These sums of £12,000, £2000, £4000 and £53,000 make a total of £71,000, which is in excess of the additional capital sought by some £3000. As regards Chenies, there is now a single settlement growing up around Chorleywood Station; and I certainly think it fair, whatever is the decision with reference to the Chenies district generally, that this settlement should be included in the area of the Company. It is in the public interest that the people in this part of Chenies who desire to take the Company's gas should have an opportunity to do so.

The standard having been fixed by Parliament it is in the nature of a parliamentary bargain upon which people take up shares?—It is.

By the CHAIRMAN: If the new capital was sold on an altered scale, it would not affect anybody. If the standard price were put at 4s. instead of 4s. 7d., the premiums would be so much less. So far as the consumer was concerned, there would be no advantage in the reduction. There had been modifications of the sliding-scale recently in the case of two of the London Companies; but that had been for consideration given.

Mr. WEDDERBURN: Now as to purchase. The suggestion of the Council in their circular was that they ought to have, and that they should endeavour to get, a purchase clause enabling them to purchase the undertaking of the Company at any time. Do you think that would be reasonable?

Witness: Most unreasonable.

Do you know of any instance where, upon a Bill for additional capital, there has been inserted a clause to be hung over the heads of the company for all time?—No.

Do you think the suggestion that they could obtain such an unheard of clause was one which they were justified in putting before their ratepayers in inducing them to vote against the Bill?—No; certainly not. Having read that circular through, I am bound to say it is a most immoral production, which ought never to have been issued.

In cross-examination by Mr. HUTCHINSON, witness said he did not think the Chairman of the Company quite appreciated the position when the questions as to purchase were put to him the previous day. The present time, when the Company were struggling into a safe dividend-paying position, was not the period when they should sell their concern. An alteration of the standard price would not effect any object with regard to new capital; but if altered with regard to the old capital it would, because at present, with the price at 4s. 7d., they could raise their dividend to the standard rates. If the standard price were below 4s. 7d., they would have to make their dividends at the lower price. Such an alteration would be a disturbance of the old bargain. The old shares amounted to £15,500. He did not know how much of this was issued subject to the sliding-scale.

Mr. HUTCHINSON: Surely you know only £5000 was so issued?

Witness: I will take it from you.

So far as £10,500 is concerned, there was no bargain made with the shareholders at all?—The bargain was a definite one made in 1885 between Parliament and the then original shareholders, under which, if they could sell gas at 4s. 7d., they were entitled to receive a 10 per cent. dividend.

You are aware that in the Lea Bridge case the standard price was reduced by 6d.?—Yes.

In further cross-examination, witness said the works required money to be spent on them immediately, though £5000 had been spent on them in the last two or three years. When £12,000 was expended on them, their capacity would be doubled. This figure was not the result of careful estimate.

The CHAIRMAN: Have you considered fully this question of the demand made by the Company that they should have the right to manufacture power gas?

Witness: I have. I have no expectation whatever that power gas, so called, will ever have the slightest vogue in a district like this.

Mr. *E. H. Stevenson*, examined by Mr. KEEN, said the existing works were not sufficient to cope with the needs of the district. In view of the rapid growth in the sale of gas, they needed extension. The consumption would double in three or four years if the mains were provided in the districts where the demand for gas had been made. It had not been at all unusual in the last few years for the sales of gas to increase immensely. He was engineer to one small undertaking which in five years had trebled its output; and at Cromer, the consumption had increased 400 per cent. in ten years. It was simply marvellous how the use of gas for cooking and heating had increased in good residential and seaside places. There was a demand here for prepayment meters; but the extension of business would arise more from the better class of ordinary consumer. Capital should be allowed sufficient to last the Company for the next fifteen years. It was a very grave matter for a small company to have to come to Parliament often. In his opinion, the Company in the next fifteen years, for the sale of coal gas, including £2000 overspent capital and a sum for working capital, would need £57,000.

Mr. KEEN: Can you explain the principle on which the standard price is based—when it is first included in the constitution of a company?

Witness: The principle of the standard price is that it should be fixed at such a figure as shall be fair to the management in ordinary normal times, and enable the Company to earn their standard rate of dividend. If by reason of expansion or better management—extra good management—they can reduce the price of gas in normal times, they ought to be able to divide a larger dividend. If in consequence of bad management they have to raise the price of gas, they ought to be penalized by having a smaller dividend. It happens that when coal is cheap they can divide more than their standard rate; but when times are bad, as they were last year and the year before, many companies have to raise the price of gas, and lose a portion of their dividend, through no fault of their own.

Do you think it is fair or reasonable that an alteration should be made in the basis when once it has been fixed?—Not unless there is good and special reason. I did advocate it in the Lea Bridge case, because there was special reason.

By the CHAIRMAN: So far as the alteration of the standard price in regard to past capital was concerned, his opinion was that it would affect the shareholders of the Company prejudicially; and if precedents were formed for the alteration of the standard price, and were anything like generally followed, it would affect all gas stock throughout the kingdom, because then no one would have any of the certainty or security—which they considered they had now—that their dividend would not be reduced, although they might be working exceedingly well and doing their duty. In fact, the more they did their duty, and the greater the difference between the standard price and the price at which they were selling gas, the more likelihood there would be of Parliament altering it in future. Therefore purchasers could not give any premium. He very much doubted, if the Lea Bridge case were to be generally followed, whether capital would be sold at par. With respect to the reduction of standard price for future capital, he did not think it mattered one iota; but if they did alter the standard price in respect of future capital, he asked them not to put in the Long Eaton clause exactly. He was for Long Eaton last year, and a legal question had arisen in connection with that clause.

The CHAIRMAN: Will this Company be entitled to make up back dividends?

Witness: No; not in any way whatever.

In further examination, witness said it was probable that some of the old capital was issued before the sliding-scale was started. Before the sliding-scale came into operation, it was the custom for original shareholders to obtain 10 per cent. maximum dividend when they first came to Parliament, and therefore 10 per cent. had always been recognized as appertaining to original shares. No doubt one of the conditions on which people acquired shares after 1885, was the statutory bargain arrived at in that year. Seeing that the price now charged by the Company was 4s. 6d. per 1000 cubic feet, he thought the standard price of 4s. 7d. very fair. If it were reduced, the only effect would be that capital issued in the future would have to be issued below par.

Mr. KEEN: It is suggested by the Council that they should have a general power to purchase the undertaking at any time?

Witness: No such clause has ever yet been inserted in the Act of a statutory company or one working under statute. Now and then a clause is inserted by agreement; but it is always limited to one year.

In cross-examination by Lord R. CECIL, witness said he calculated that at the end of fifteen years the Company would be selling 85 million cubic feet of gas—that was, taking the increase at 10 or 11 per cent. per annum. He had not taken out any figures of the population which might be expected in the district. He could not split up the £57,000 into the items required for main extensions, and for works, &c.

This ended the case for the promoters.

Lord R. CECIL: I propose to commence with the Chenies evidence.

The CHAIRMAN: We shall not trouble you about Chenies. We should like to hear first about the feeling of the locality.

Lord R. CECIL informed the Committee that the population of the gas area was 6974 in 1891, and 8232 in 1901.

Mr. *Lomas*, Clerk to the Urban District Council of Rickmansworth, examined by Lord R. CECIL, said the feeling of the locality was that the capital asked for was out of all proportion to the requirements of the district. There was a meeting of the ratepayers under the Borough Funds Act, which was properly convened; and at this meeting about seven hands were held up against the resolution in favour of the Council opposing the Bill. At a poll subsequently, the resolution was carried by a large majority. The ratepayers thought the Company were entitled to a reasonable increase of capital, which they could have obtained by Provisional Order. This would have been very much cheaper for both the Company and the Council. If the Company were granted the power to convert their capital, it would increase their nominal capital from £15,000 to £28,000, which would automatically increase their borrowing powers, if they were given authority, as was usual, to borrow a proportion of the capital. This would not be proper. The district considered the standard price of 4s. 7d. too high, especially in connection with the conversion. It was the same as in 1885; and Rickmansworth held that they, the lucrative part of the district, ought to have some concession made to them. The watering of the capital in 1884, just before the standard price was fixed, gave the district a strong claim in this respect. In view of the extravagant proposals of the Bill, the Council asked that it should be rejected, or, if passed, that the capital should be cut down, the standard price altered, and a purchase clause inserted.

In cross-examination by Mr. WEDDERBURN, witness said one of the objections to the Bill was that at present, on a capital of £15,000, £933 could be divided; whereas, by converting this capital into £28,000, at 5 per cent., the shareholders would be entitled to divide £1400 before making any concession to the public. The sewerage scheme which the Council were undertaking would cost about £30,000, which was more than the rateable value of the district. Asked whether, in these circumstances, the Council would be likely to want to purchase the gas-works, witness said they still had a margin of £15,000 of borrowing powers.

The room was then cleared. On the re-admission of the parties,

The CHAIRMAN said: The Committee wish the parties an opportunity of coming to an agreement. They think that, in spite of the heated discussions which appear to have taken place up to to-day, it is right, in the interests of the population, that an attempt should be made to come to an agreement.

Mr. WEDDERBURN: Would the Committee render further assistance by giving an indication of their view?

The CHAIRMAN: We are of opinion that the capital named is very far in excess of the needs of the neighbourhood.

Mr. WEDDERBURN: If the amount of capital is the point, I have no doubt we can agree.

The CHAIRMAN: I cannot go any further towards indicating what we should like the Council and the Company to agree about, because we do not know what else there may be that the Council lay great stress upon; but we do think a settlement ought to be come to.

Lord R. CECIL: I think it would not be at all impossible, if my learned friend would consent to nominate some reasonable person to represent his Company.

The CHAIRMAN: I may say we shall not allow power gas. I think it is entirely contrary to public policy that the right to make power gas should be allowed in isolated places up and down the country. Just as it is improper to allow little spots to be taken out of the country for the supply of electric power, so we think it improper in the case of power gas.

Friday, June 13.

On the resumption of the proceedings to-day,

The CHAIRMAN asked what arrangements had been made since Wednesday.

Mr. WEDDERBURN said, as he understood, there would be no difficulty in arranging this matter, but for one thing which the opponents had raised. As the Committee knew, owing to the action of the Urban District Council in offering opposition without having first complied with the Borough Funds Act, the Company, for their own protection, went to Mr. Justice Kekewich, who granted them an interim injunction, with costs. There was no reason why that action should proceed now, and he was quite willing it should cease; but the petitioners asked the Committee to reverse the Judge's decision, and say the Council should not pay the Company the costs.

Mr. HUTCHINSON said the Judge had not given the Company costs. He had granted an interim injunction restraining the Council from charging the district fund with any of the costs of opposition; and the costs in that were to be costs in the action.

Mr. WEDDERBURN said if the Judge had not given the Company costs, when the case as to whether it was right to bring the action came before the Judge he would decide that matter. It would be difficult for the Committee to go into that point now. Apart from this, the Company had consented to give the Council the purchase clause on the lines of the Long Eaton clause; and they had agreed that the new capital should be £24,000—that was, £18,000 additional capital, with the usual borrowing powers as to one-third, or £6000. It had also been agreed that while the Council were determining whether or not they would act on the purchase clause, the Company were not, without the consent of the Council, to raise more than £8000. Thus the Company would be restrained from raising immediately all the capital authorized; but the Council had to decide within a given time—before December next—whether they would or would not apply for purchase. If they did not apply for purchase, the Company would be able to raise the whole £24,000. When this sum was exhausted, they would have to apply to Parliament again, and that application would probably be much earlier than they had intended should be the case. All the clauses with reference to power gas, having regard to what had fallen from the Chairman, were struck out; and the standard price was not to be altered.

The CHAIRMAN: It would be a great satisfaction to the Committee if the parties left this room absolutely in peace—if no more money was spent in this neighbourhood, and especially if no more bad blood was created.

Mr. HUTCHINSON said the reason his clients gave him instructions with regard to the costs was that they said there must be a complete settlement of everything. This could only be attained by deciding everything before the Committee. He would not discuss the question of costs. The prospect of the Company getting the costs was absolutely hopeless.

Mr. WEDDERBURN agreed that it was desirable the matter should be settled; but he did not agree that if the action proceeded the Company would not get their costs. If the Company waived the costs, it would be very hard, because they had had to face the expense of a double fight. They had had all the expense of going before the House of Lords; and had it not been that they desired not to be hard on Mr. Lomas, who had indemnified the District Council, the Company would certainly have asked for their costs of appearing in the House of Lords.

The CHAIRMAN: I think this question of the costs may be left to Mr. Justice Kekewich.

Mr. WEDDERBURN: I think we have agreed to it. Sub-clause 4 of the new clause embodying the Long Eaton clause runs as follows: "In addition to the sum to be paid by the Council to the Company under the foregoing provisions of the section, the Council shall pay to the Company the actual costs, charges, and expenses of obtaining this Act, and the costs, charges, and expenses incurred by them of, and incident to, the winding-up of the Company." We propose to add after Act, "including the costs of the action *Attorney-General v. Rickmansworth Urban District Council.*"

Lord R. CECIL: No; that would be the whole of the costs.

The CHAIRMAN: We are content with this sub-section 4, and do not propose to put in the words that you have suggested; and we ask from you a pledge that the action shall be dropped.

Mr. WEDDERBURN: I want to avoid difficulty in the future. There may be some trouble about that. It will not be in our power to drop the action. If we were to withdraw, we should have to pay their costs, and that they could never ask for.

Mr. HUTCHINSON: There is such a thing to be obtained as an Order of Discontinuance—the parties to pay their own costs.

Mr. WEDDERBURN: If you agree.

Mr. HUTCHINSON: We agree. You shall apply for an Order of Discontinuance—the parties to pay their own costs.

Mr. WEDDERBURN: That will be enough. The only thing we want is that when we go to arbitration and are putting in our legal expenses, it ought not to be said: "This was an action they should never have brought." We ought to be entitled to bring into account, not the whole of our costs, but the costs of the action.

Mr. HUTCHINSON: That would be another way of getting it in the clause.

The CHAIRMAN: I cannot understand that any valuer would include this in the value of the works.

Mr. WEDDERBURN: No; but legal and parliamentary expenses would come in. We have not been wrong in bringing our action, as far as we can determine, because the Judge has been with us upon it.

The CHAIRMAN: I will not say anything about the feeling of the Committee upon that point. I think it is quite sufficiently indicated by the expression of our wish that this matter should be absolutely dropped for ever. I do not consent to the last request that the costs of the action before Mr. Justice Kekewich should be considered part of the value.

Mr. HUTCHINSON said he would undertake not to mention these costs, when before the arbitrator, as an expense incurred wrongly.

The CHAIRMAN: We find the preamble proved.

The clauses were then adjusted, and the Bill, as amended, was ordered to be reported to the House for third reading.

Parliamentary Reports.—Owing to the large bulk of matter with which we have to deal this week, in consequence of the meeting of the Gas Institute, we are compelled to hold over to the next issue of the "JOURNAL" several columns of parliamentary proceedings, together with the "Gleanings from the Committee-Rooms."

LEGAL INTELLIGENCE.

MANCHESTER CITY POLICE COURT.—Friday, June 13.

(*Before Messrs.* SWIFT, ELLIOTT, *and* CHADWICK, *Magistrates.*)

Manchester Corporation v. Sinclair—A Disputed Gas Account.

This was a case in which Dr. W. J. Sinclair was summoned by the Manchester Corporation Gas Department for not paying £6 os. 8d., the balance of an account amounting to £16 os. 8d. for gas supplied during the quarter ended March 31 last. Dr. Sinclair during that quarter was the occupier of two houses—one in Stanley Grove and the other at No. 250, Oxford Street. He was charged £10 13s. 5d. for gas used in the Stanley Grove house, and £5 7s. 3d. in respect of the Oxford Street premises. In each case the circumstances were exceptional; and Dr. Sinclair, believing that the meters had erred, or that a mistake had been made somewhere, declined to pay the full amount claimed. He tendered £10 as sufficient for the gas he had actually consumed; and it was accepted as a payment on account.

Mr. BELL appeared for the Gas Department; and Mr. GIBBONS represented Dr. Sinclair.

Evidence in support of the case having been given,

Mr. GIBBONS said there were one or two extraordinary circumstances which the Court were invited to consider. It was common knowledge that gas-meters told stories; but the meter in the Oxford Street house was not only a story-teller, but a story-teller of the very worst kind. It might be that the inspector was right and the meter wrong, or that the meter was right and the inspector wrong. If the inspector was right, all he could say was there was something radically wrong with the meter. Of course, in law the register was *primâ facie* evidence of the amount of gas consumed; but there was an instance recorded in which the magistrates set aside the meter's testimony in favour of oral testimony. They found on the evidence that, as a matter of fact, the meter was wrong, and that nothing was due. Counsel could not ask the Magistrates to say nothing was due in this case; he only asked them to say that the £10 which Dr. Sinclair had paid was enough. On April 25, Dr. Sinclair wrote to the Gas Department a letter in which he acknowledged receipt of the account for £5 7s. 3d. for the Oxford Street house, and intimated that he regarded the charge as excessive. Until the end of December, Dr. Sinclair lived with his family in the Oxford Street house, and was very extravagant in the use of gas. Early in the year, he removed to the house in Stanley Grove; and the Oxford Street house thereafter was only occupied by one or two servants. There was not anything like the amount of gas consumed as previously, and yet the bill was almost exactly the same as it had been for years past. Then as to the bill for the Stanley Grove house, there was something dreadfully wrong. Up to the end of December, the house was a nursing home, containing twelve rooms for patients; and there were also rooms for matron, nurses, and servants. Lights were burning all through the night; and there was a considerable amount of cooking by gas. Dr. Sinclair had the house altered into a place of residence for himself and family; and during the ensuing three months very little gas was used. Again, however, the bill was almost exactly the same as those which had been presented for years in respect of that house.

Mr. BELL said that was not so.

Mr. GIBBONS: Mr. Bell says that is not so. Perhaps I am a penny wrong; but I have a number of demand notes here. Dr. Sinclair does not want more than his just due. He has thought it right to bring this matter before the Bench and the Manchester public, who are always disputing their gas bills, because he thinks a mistake has been made, and that he is being charged for gas which he has not used.

Mr. BELL, in reply to the Magistrates, said the charge for the Stanley Grove house for the December quarter was £11 17s. 4d., and for the March quarter £10 13s. 5d. For the December quarter at the Oxford Street house the charge was £6 14s. 2d., and for the March quarter £5 7s. 3d.

Mr. GIBBONS remarked that the charge for the Stanley Grove house for the March quarter of 1900 was £10 15s. 2d.; the price being 2s. 3d., as against 2s. 9d. per 1000 cubic feet now.

Mr. CHADWICK: Do you dispute the reading of the meter for the March quarter?

Mr. GIBBONS: I cannot contradict what the witnesses have stated; but it is for the Court to say whether, as a question of fact, the meter was right or wrong. The reading may be right and the meter may be wrong.

Mr. CHADWICK: Can you give us any suggestion why the meter is wrong?

Mr. GIBBONS: I am going to call evidence to show that it must be wrong.

Mr. CHADWICK: Do you dispute the register?

Mr. GIBBONS: I do not know. That is only *primâ facie* evidence. It is not conclusive evidence at all.

Dr. *Sinclair* then gave evidence in support of Counsel's statement. He added that during part of the quarter the Stanley Grove house was in the hands of the decorators. At the Oxford Street house, there was a caretaker in charge in the day time and a servant slept there at night. One of his daughters also slept there. He submitted that it was simply impossible that the amount of gas charged for could have been consumed under the circumstances.

Mr. BELL: The gas-meter at Stanley Grove is your property?

Witness: I do not know. It was put in by an authorized gas-fitter. I have been charged for it all the time.

No. It is the stove that has been charged for; not the meter?—I did not know that.

In your letter of April 25, did you not write: "I have had the meter at No. 4, Stanley Grove examined, and it is reported as acting perfectly"?—Yes.

So you have had the meter at Stanley Grove examined, and it does not belong to the Corporation; and it is the Stanley Grove account you complain of most?—That is the more extraordinary one; but I complain of both.

Have you ever asked for the meter at Oxford Street to be examined or tested?—No. I paid my bills and assumed matters were right.

The premises, after you removed, were left pretty much in the hands of servants?—Yes.

Is it not a matter of common knowledge that, when premises are left in the hands of servants, there is a good deal more gas consumed than when the occupier is there?—The house was always in darkness. I passed it many times at night; and I have been in it.

Mr. BELL said that at the Oxford Street house in the quarter ended March, 1900, when the price of gas was 2s. 3d. per 1000 cubic feet, Dr. Sinclair consumed 71,000 feet. In the March quarter, 1901, he consumed 57,300 feet; whereas in March, 1902, he had only consumed 38,000 cubic feet. The difference in the amount consumed between the March quarter of 1901 and the corresponding quarter of 1902 was 19,000 cubic feet. In regard to the Stanley Grove premises, in the quarter ended March, 1900, the consumption was 94,400 feet, and for the 1901 quarter it was 88,500 feet; whereas in the March quarter, 1902, it was 76,700 feet, or 12,000 cubic feet less. The price two years ago was 2s. 3d., then it was raised to 2s. 6d., and now it was 2s. 9d. per 1000 cubic feet; so that although the quantity consumed was smaller, the bills would not be proportionately lessened.

Evidence in corroboration of Dr. Sinclair's statement having been given, the Magistrates retired to consider their decision. On their return,

Mr. SWIFT said they had given the case full consideration. They fully appreciated the spirit in which Dr. Sinclair had taken up the matter, and that this had been a question not of pounds, shillings, and pence, but of principle with him. Taking all the facts into consideration, however, and remembering that the correctness of the register was not disputed, the Bench had no option but to make an order for the payment of the amount claimed. At the same time, they wished to remind the public that if there was any doubt as to the correctness of a meter, it was the duty of the owner or occupier to send notice to the proper quarter, so that it might be tested. Dr. Sinclair could have the meter tested; and if it were found incorrect, he would have his remedy for any wrong that had been done.

Mr. BELL: We shall be pleased to assist in testing the meters, if necessary, when asked to do so.

The Innerleithen Gas Company's Constitution.

The First Division of the Court of Session considered last Friday the petition by the Innerleithen Gaslight Company, Limited, in which the sanction of the Court was asked to an alteration upon the constitution of the Company. (See *ante*. p. 215.) The Court remitted the petition to Sir Charles B. Logan to consider, and his report upon it was submitted. He pointed out therein that it was proposed to take power to manufacture and dispose of not only gas but other lighting, heating, or motive power, which would enable the Company to undertake the manufacture and disposal of electricity for these purposes. It did not appear to him that this alteration was required to enable the Company to carry on their business more economically or more efficiently; and the generation of electricity, for example, might not be considered to be a business to be conveniently or advantageously combined with the manufacture of gas. On the other hand, the alteration might perhaps be held to be required in order to enable the Company to attain their main purpose (the manufacture of lighting, heating, or motive power) by new or improved means, in which case the alteration would be one of the class contemplated by the Companies' Act of 1890. If, however, the alteration of the objects of a company was such that the name became misleading, the Courts, in both Scotland and England, had usually imposed the condition that the name should be changed in order to indicate the enlarged nature of the business. The case was, so far as he was aware, the first in which the Court had been asked to substitute a Memorandum and Articles of Association for a contract of co-partnery; and he deemed it to be his duty to examine them, not only for the purpose of ascertaining how far they might extend the objects for which the Company was originally formed, but also for the purpose of being satisfied that the alterations did not confer, or pretend to confer, on the Company or the Directors powers which were *ultra vires* or illegal. Article 6 permitted the Directors to issue, sell,

or dispose of shares of the Company at such discount or on such other conditions as they might be able to attain. The Courts had repeatedly affirmed the principle that shares must not be issued at a discount. It therefore appeared to him that the proposal was illegal. The proceedings had been regularly gone about, and, subject to the points re'erred to, the petition should, in his opinion, be granted. At the hearing of the petition, it was stated that the Company had no desire to engage in any business other than that connected with gas supply, and that they agreed to the deletion from the Articles of Association of the words "or other lighting or heating or motive power." The Court struck out article 6; otherwise they granted the petition.

Heavy Sentence for Robbing Meters.

The two men, Thomas Webb and G. M. Carter, who were recently committed for trial at the West London Police Court on six charges of stealing money from automatic meters belonging to the Gaslight and Coke Company (*ante*, p. 1505), last week pleaded guilty to the offences at the Clerkenwell Sessions. The prisoners were members of an organized gang who for some months had been engaged in systematically robbing almost every prepayment gas-meter they could come across in the neighbourhood of Fulham, by means of a duplicate key. Carter was sentenced to 21 months' and Webb to 18 months' imprisonment, with hard labour.

Claim for Wages in Lieu of Notice.

At the Sheffield County Court last Friday, a gas worker and general labourer named Thomas Bray sought to recover £3 10s. wages, in lieu of a fortnight's notice, from the Sheffield United Gaslight Company. From the evidence, it appeared that plaintiff had been frequently employed by the Company during the last ten years. His last engagement commenced in September, 1901. On Dec. 7 a printed notice was served upon all the men employed in a similar capacity to plaintiff, stating that at the end of fourteen days their services would not be required, except on daily engagements. Plaintiff continued to work after the expiration of that notice. Without any fresh terms being specifically arranged, plaintiff was put on to work in the retort-house, in which a printed notice was exhibited stating that all men in the retort-house who worked more than fourteen consecutive shifts were required to give fourteen days' notice before leaving the Company's employment; and the Company, on their part, agreed to give a similar notice. For the plaintiff, it was contended that the notices given on Dec. 7 were only intended to enable the Company to reduce their staff through the Christmas holidays, and that men who continued after that time, and worked for fourteen consecutive shifts in the retort-house, came under the terms of the printed rule. For the defendants, it was argued that after the receipt of these notices, each man was simply a daily servant, and not entitled to notice. His Honour Judge Waddy, K.C., in giving judgment for the defendants, said that he did so rather unwillingly, because it appeared to be a somewhat harsh way of dealing with the men. If it was decided to appeal, he would be glad to render all the assistance he reasonably could.

Refusing Admittance to a Meter Inspector.

Before the Altrincham Magistrates, on Monday of last week, a woman named Shaw, living at Ashton-on-Mersey, was summoned by the Stretford Gas Company for having refused an inspector permission to enter her house in order to read the gas-meter. Mr. W. W. Johnson, Collector to the Company, said defendant had refused admission several times. It was notified to her that the inspector would call on April 24 He did so, in company with witness, but was refused admittance. It would be understood, he remarked, that if such a practice became general it would cause much inconvenience. Defendant seemed to have had a grievance because on one occasion previously the supply of gas to her house had been cut off. Defendant, who did not appear, was fined 20s.

The Corporation of London and the Price of Gas.—At the Meeting of the Court of Common Council of the City of London last Thursday, the Streets Committee reported upon the reference to them on the 15th ult. of a letter from the London County Council on the subject of the charge for gas in the district of the Gaslight and Coke Company north of the Thames, and asking the co-operation of the Corporation in initiating legislation with the object of effecting some improvement for the benefit of the consumers. The Committee recommended compliance with the request. The matter was unanimously referred back for them to co-operate with the Council, on the understanding that "the advantages secured to the Local Authorities on the north side of the Thames by the City of London Gas Act, 1868, and the Amalgamation Scheme, 1883, as to the supply of gas for public purposes, should not be interfered with."

Morecambe Gas Supply.—At the meeting of the Morecambe District Council on Monday last week, Mr. Abbott presented the report of the first year's working of the Gas Department. The total receipts on revenue account amounted to £15,860, and the expenditure to £9501; the gross profits being £6359, which added to a balance of £569 from the previous year made £6928 available for interest, redemption, and income-tax. The interest on bonds (£148,000) amounted to £5574; on £9000 mortgage, £190; on a £100 bond, £1 13s.; bank interest and deposit, £334; income-tax, £375; and principal repaid £1662. Mr. Abbott said the expenditure on capital account during the year had been £11,260; bringing up the total to £169,561. The gas made amounted to 74,146,000 cubic feet. The output of gas showed an increase of 375,400 cubic feet, or 5·5 per cent.; and the income, a rise of £379. This was largely due to the prepayment system, as since July last they had sent out 531 slot meters and 223 cookers. The amount of gas consumed by them was 2,253,400 cubic feet, and the income derived was £471 10s. 1d., or 113,170 pennies. This showed that the condition of the works was not quite so bad as had been pictured; and the Committee hoped, so far as an approximate estimate was concerned, that they would not have to ask for any assistance from the rates for the year 1903. The Committee's minutes were confirmed.

MISCELLANEOUS NEWS.

THE LONDON COUNTY COUNCIL AND GAS SUPPLY.

Promotion of a Bill Approved.

At the Meeting of the London County Council last Tuesday, the report of the Public Control Committee given in the "JOURNAL" last week (p. 1584) was presented. The Chairman of the Committee (Mr. W. J. Squires), in moving the adoption of the recommendation that the Council should promote legislation next session to obtain a reduction in the price and illuminating power of the gas supplied by the Gaslight and Coke Company, said members of the Council would like to know now that a communication had been received from the Corporation of the City of London to the effect that the Streets Committee proposed to recommend the Corporation to co-operate with the Council in bringing in a Bill for the reduction of the Company's charges north of the Thames. Mr. R. Melvill Beachcroft said he noticed that they were told in the report that the Solicitor "thinks it could be held that the Council had power to spend money in promoting a Bill as proposed." The Solicitor did not say that it would be, but that it could be held that the Council had the power to spend the money for the purpose named. He asked the Chairman of the Committee if he would kindly tell the Council whether they might read the word "could" to mean "would," and, further, say whether he had any objection to adding to his recommendation words to the effect that a copy of the Bill, when prepared, should be sent to the President of the Board of Trade for his consideration. Mr. Squires said, in answer to the first question, he would rather not anticipate what the Solicitor meant. All the Committee said was that he gave them his opinion on this matter. With regard to the second question, he certainly had no objection. Mr. Beachcroft said, this being the case, he would move the addition of the words, "and that a copy of the Bill, when prepared, be sent to the President of the Board of Trade for his consideration." The recommendation, as amended, was agreed to.

NEXT YEAR'S EXAMINATIONS IN GAS MANUFACTURE.

The programme of the technological examinations of the City and Guilds of London Institute for the season 1902-3 was issued last Thursday by Messrs. Whittaker and Co., of Paternoster Square, E.C. Those of our younger readers who purpose submitting themselves for examination in the subject of "Gas Manufacture" will find from the programme that the date fixed for both grades is May 2, 1903, from 2.30 to 6.30 p.m., and that the questions they will be expected to answer will be founded on such subjects as the following:—

ORDINARY GRADE.

(1) The construction of a retort or oven best adapted for the destructive distillation of coal. (2) The setting of retorts and the construction of retort-furnaces. (3) The effects of temperature in modifying the quantity and quality of gas produced. (4) The description and arrangement of apparatus employed for the conveyance of the gas immediately upon its leaving the retorts. (5) Apparatus best adapted for cooling the gas, and for removing the products of condensation. (6) The methods of removing the gaseous impurities from the cooled gas, including a description of the materials employed, and the most suitable condition of the gas for effective purification. (7) The use of an exhauster. (8) The methods employed for controlling the pressure at the works, so as to secure an adequate supply of gas at the various points of consumption, with a due regard for economical effect. (9) The various instruments used in gas-works for ascertaining and recording pressure and exhaust. (10) The laying of mains and service pipes. (11) The construction and fixing of gas-meters, and the fitting up of premises for the supply of gas. (12) The various forms of gas-burners in general use. (13) The simplest methods of ascertaining the illuminating power of gas. (14) The simpler physical and chemical principles involved in the various processes of the gas manufacture and in the tests for ascertaining the illuminating power and purity of the gas and the value of the bye-products. (15) The practical method of carrying out these tests. (16) Influence of temperature and pressure on the volume of the gas.

HONOURS GRADE.

(1) The characteristic properties of the various kinds of coal, and their value for gas-making purposes. (2) The effects of temperature upon the production of residuals. (3) The chemical composition of coal gas, and the effect of each component upon the illuminating and calorific power of the gas. (4) The principles of combustion, and their application to the working of retort-furnaces. (5) The more advanced physical and chemical principles involved in the processes of destructive distillation of coal, and in the condensation and purification of the resulting gas. (6) The methods of gas analysis, including those for ascertaining the amount of impurities in the crude gas. (7) The practice of photometry, and the determination of the calorific power of gas. (8) The best means of burning the gas in order to develop its illuminating power to the greatest advantage. (9) Labour-saving appliances in the retort-house, and the working of retorts. (10) The construction of gasholders, purifiers, and other gas apparatus. (11) The management of the various portions of the plant, in order to obtain the best efficiency of the apparatus, with due regard to economy in working. (12) The method of dealing with such emergencies as are of more common occurrence in gas-works through breakdown of machinery or other failure of plant. (13) The working up of ammoniacal liquor. (14) The manufacture and purification of carburetted water gas. (15) Methods of enrichment of coal gas by means of oil, &c. (16) Such important recent developments of the gas industry as have been fully described in the Technical Press.

Certificates are awarded on the results of each examination;

but for the full technological certificate the candidate must also qualify according to the rules. The works recommended are set forth in the programme; and the following prizes are open for competition: Ordinary Grade: (1) Salters' Company's prize of £1, and the Institute's silver medal; (2) do., and the bronze medal; (3) the bronze medal. Honours Grade: (1) Salters' Company's prize of £2, and the Institute's silver medal; (2) do., and the bronze medal.

BURTON GAS AND ELECTRICITY SUPPLY.

The Past Year's Working—A Drain upon the Gas Reserve Fund.

At the Meeting of the Burton-upon-Trent Corporation last Wednesday, the accounts in connection with the gas and electric light undertakings (of which Mr. F. L. Ramsden is the Manager and Engineer) for the year ending the 31st of March were presented. The former show that the sale of gas produced a revenue of £41,460, compared with £38,926 in the preceding twelve months; street lighting figures for £4575, against £4636; meter and stove rents were £1115, against £951; coke, tar, and spent lime brought in £8683, compared with £11,583; sulphate of ammonia, £1074, against £2202; spent oxide, ammoniacal liquor, &c., £2109, against nothing before; and the total income was £59,871, compared with £59,075. On the expenditure side of the account, coal cost £26,916, and stokers' wages amounted to £5449, compared with £27,724 and £5008; and the total expenses (inclusive of interest, repayment of loan, deterioration, &c.) came to £55,372, against £52,679. The profit for the year was consequently £4499, compared with £6396.

Mr. T. E. Lowe, in making his annual statement in regard to the gas undertaking, expressed regret that the profits were nearly £2000 less than they were last year; but the reason was not far to seek, as this was accounted for by the heavy drop in the prices of residuals. Had the coke realized the same price as before, they would have made £3272 more than they actually had done; and in the case of tar there would have been £666 more. There was consequently a total loss of £3932 through the fall in these items. The revenue account showed that loss at £2889; and as more coke and tar was sold, this accounted for the discrepancy. Though the Committee anticipated this drop last year, the slump had been much greater than they had expected. Looking into the facts and figures more closely, they found that the gas consumption had increased by more than 28 million cubic feet, or 9·64 per cent. They had paid less for coal; but they had lowered the price of gas from 2s. 11d. to 2s. 8d. per 1000 cubic feet, or by 8½ per cent. The ordinary consumers remained about the same, but during the year the Committee had fixed 1008 slot meters. Their capital outlay stood at £191,994, of which upwards of £100,000 had been repaid. Their loan debt stood at £43,272; but they could still raise to the amount of £38,781. He next drew the special attention of the Council to the very large sum spent in repairs to mains and services—£881 last year, against £479 in 1900-1901, which was an increase of more than £400. This was due to sewering the town; and he feared that the constant disturbance of the streets caused the pipes to be broken—a result which was likely to continue for some time, as the loss of gas by leakage had been continually on the increase. Coming to the reserve fund, he asked for careful consideration to this matter. In 1898 the fund amounted to £10,346; but the next year Park Hill was sold for £6250, which money belonged to the fund, and was added, making a total of £16,596—a proper sum for the fund to remain at. Since then the profits made amounted to £29,052; and they were added to the fund. But £38,077 had been withdrawn, including £33,000 in aid of the rates and £3570 for the electric light; and this reduced the amount to £7571. This fund was not under the control of the Committee, though he had always advocated that it should be. He felt strongly on this matter, and trusted that he had made himself clear, and that the Council would remember that the reserve fund must not be drawn on in future, unless there was an imperative necessity, as it was already pledged up to the hilt. As the fund was the working capital of the gas undertaking, their financial position was unsound. The Finance Committee drew a year in advance before they knew whether the profit earned in the previous year would meet the amount drawn. For instance, they had arranged in this year's rate to draw £6250 before they were aware that last year's profits amounted to £1750 less than they had actually drawn. In his opinion, a Joint Committee, composed of a few members of the Finance and Gas Committees, should administer the fund. It was even possible that the Electric Lighting Department might be accused of drawing too freely on the fund. They had borrowed this year £1020, and proposed to pay back £520 out of the profits of the electric light works. The accounts for that undertaking showed a profit of £545, which was, no doubt, encouraging, as the Council must bear in mind that had the overspent capital been borrowed, and the interest and repayment had to be met, the profit would have been reduced to £110. He thought the Council would admit that they were providing a good and a reliable light, and that though many corporations had had to apply for aid from the rates for their electric light undertakings, the Burton supply was self-supporting.

Mr. Hutchinson said he thought the gas consumers of the town were being treated exceedingly unfairly. The Council ought to do as they did in other towns. For many years past the consumers of gas in Burton had been charged an exorbitant price. This was an unjust policy, and the consumers ought to be more fairly treated by a distribution of the profits arising from the results of their expenditure of money in gas.

Mr. Rowland said that during the past four years they had spent not only the £6250 from the sale of the Park Hill Estate, but had drawn £2446 from the reserve fund. The money taken was equal to a rate of 8½d. in the pound, or a 2d. rate above the whole of the profits during the four years. This was an entirely unsound financial policy, and if they carried it on longer they would have to stop through a process of exhaustion. They must face the matter boldly; and if they had to spend money in the town in other directions, they would have to find it in the orthodox method from the rates, and not by a perpetual drain upon the profits of the gas-works.

MALTA AND MEDITERRANEAN GAS COMPANY, LIMITED.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, No. 60, Gracechurch Street, E.C.—Colonel J. Le Geyt Daniell in the chair.

The Secretary (Mr. A. W. Cooper) read the notice convening the meeting, and the certificate of the Auditors; and the Directors' report and the accounts were taken as read.

The report stated that there had been an improvement in the year's working, resulting from an increase in gas-rental and a material decrease in the cost of coal. The balance of the general revenue account was £4874; and the Directors recommended the payment of the usual dividends on the first and second preference capital, and a dividend of 3 per cent. on the ordinary capital (making, with the interim dividend paid in December last, 5 per cent. for the year), leaving a balance of £765 to be carried forward.

The Chairman said he had to regret the absence of two of the Directors—Mr. Stephenson R. Clarke and Mr. Basil T. Makins. The former was still soldiering in South Africa; but he hoped that long before the shareholders met again he would be back among them. Mr. Makins, he was sorry to say, was very unwell. With regard to the operations of the Company during the financial year ending March 31 last, it afforded the Directors very much satisfaction to report the decided improvement which the shareholders would see from the accounts had taken place. This improvement was noticeable in the amount of gas sold, the lower price paid for coal, and the reduction of freights, which, all combined, had contributed to the increased balance carried to the general revenue account, the amount of which was £9744, as compared with £6282 in the previous year. Although they had not derived, in the period embraced in the accounts, the full benefit of the reduction in the price of coal, it would be satisfactory to the proprietors to know that they paid £3841 less under this head than in the preceding twelve months; and this reduction worked out at something like 7s. per ton. The amount received for gas showed an increase of £1379; the quantity sold being 94,381,000 cubic feet, as against 89,510,000 cubic feet—or 5 per cent. more. In the profit and loss account, the cost of maintenance would no doubt have attracted their attention, as it exhibited an increase of £969. This was due to necessary expenditure on account of mains and services; and he might add that Malta was responsible for it all. General charges also were £173 more, which was likewise on Malta account. Taking the credit side of the profit and loss account, he had already mentioned some of the details of the gas-rental. They would observe that the returns from coke were some £500 less—the figures being £5475 this year, as compared with £5978 in the preceding twelve months. On the other hand, however, pitch and tar had done better by £50. Coming to the general balance-sheet, they had been obliged—in view of the large amount of "Sundry debtors," and also in view of the high price of coal some time ago—to provide additional working capital, and so they had issued another £5000 of debentures. This now came into the accounts, making the amount £21,000 odd, as against £16,000 a year ago. On the other side of the account, stocks at stations stood at £9739, as compared with £10,213 in the preceding twelve months; and sundry debtors figured at £13,149, as against £10,847. The amount of the latter item was due to a large extent to the municipal debt of Trapani. Perhaps it would be better to refer to this matter at once; and therefore he would take that station first. The Municipality of Trapani owed the Company on an old debt £5801, for which they had obtained a judgment in the Courts. This matter, as the shareholders might suppose, had received, and was still receiving, the very anxious attention of the Directors, because the Municipality, as was the case with many Italian municipalities, could not at the moment pay the money. The Board were, however, assured that the debt was absolutely secured. Some time ago he placed himself at the disposal of the Board of Directors, if they thought fit, to go out and ascertain whether any personal negotiations would be of service there; but it was thought best to send over specially from Rome a gentleman whom they had employed before. This gentleman was a Solicitor, and advised the English Consulate; and he was recommended to him (the Chairman) personally, when he was in Rome, by the English Consulate, as well as by the Minister there. He was despatched to confer with the Company's legal representative in Trapani. The latter gentleman had the complete confidence of the Board; but, being a local man, they thought that someone practicing in the Courts at Rome would carry greater weight Well, they had been assured that the Municipality of Trapani would obtain an Act of Parliament which would enable them to raise a loan, and that the Company would be the first of the creditors to be paid out of this loan. The gentleman whose services they had engaged was watching the whole thing at Rome; and only that morning the Directors had received from him a letter saying that immediately one of the Ministers returned he would see him again with regard to the Act of Parliament to allow the Trapani people to borrow the money in question. This was their experience some years ago at Marsala. There the Municipality obtained a loan and paid them off; and that was the condition of most of the municipalities in Italy. Their financial position, unfortunately, was not so strong as it used to be. The Company could but go upon the advice and the opinions of those whom they employed; and in them they had every confidence. Therefore he looked upon this debt as absolutely good. The rental at Trapani showed an increase of about 4½ per cent. At Marsala, the gas-rental was the same—£2740—and there was a slight decrease in the receipts from coke. In fact, at all the stations there had been a less amount received for coke. Coming to Malta, which was the principal station of the Company, there was a most decided improvement under the direction of their General Manager and his two very able assistants. The profit for the past year was one of the best in the Company's history—showing an increase of £3747, resulting from a large growth in the sale of gas and, in a measure, from the reduction in the price of coal. The make of gas was 10,185 cubic feet per ton; while the sales exhibited a remarkable increase—amounting to 70,748,000 cubic feet, or an advance of 7 per cent. But for the check to progress which arose in consequence of the increase in the price of gas in that direction, he really believed they would by now

have made up the whole of the amount that they lost in the years 1897 and 1898 by the introduction of the electric light. The growth in consumption for the past two years had been about 4,500,000 cubic feet; and during last year 3,500,000 cubic feet of this was for private consumption alone. The Directors had under consideration a reduction in the price of gas; but the good people of Malta who supported the Company ought, he thought, to remember that the increase they had been obliged to make in the price was not at all commensurate with the increase in the cost of coal. Otherwise the consumers would have had to pay more. It naturally took a little time for the Company to recoup themselves the portion of the burden they had had to bear; but he could assure the consumers that the Board had no desire to keep them out of any advantage that might be gained by the recent reduction in the price of coal. The question was having the serious consideration of the Directors. He was happy to be able to inform them that they had just completed the negotiations for a new contract with the Admiralty for another three years; and he had that morning heard that this contract had been signed. Taking all things into consideration, he hoped the shareholders would agree with the Directors that, with perhaps the exception of the Trapani affair, the position of the Company was a sound one, and that they had done very well in the year under review. He concluded by moving the adoption of the report and accounts.

Mr. A. M. PADDON, in seconding the motion, said they would all understand that an undertaking like theirs, carrying on operations abroad, was in some ways more complicated than one whose business was situated at home. They had to be prepared for emergencies which companies working in this country were not asked to meet. As far as the coming year was concerned, however, he did not see that there was any diminution in their favourable prospects. They were still just as well placed as was the case a year ago; and he hoped that when next they met all the improvements reported on the present occasion might be found to have been not only maintained but increased.

The resolution was then carried unanimously.

On the motion of the CHAIRMAN, seconded by Mr. PADDON, dividends were next declared at the rates of 7 per cent. on the first preference shares, 7½ per cent. on the second preference shares, and 5 per cent. per annum on the ordinary shares—deducting the payments already made on account.

The retiring Director (Mr. A. M. Paddon) and the Auditors (Messrs. R. Hesketh Jones and Thomas Guyatt) having been re-elected,

Votes of thanks were accorded to the Chairman and Directors, the Secretary, the General Manager (Mr. Starkey) and Engineers (Messrs. Robert Wilson and W. A. Reid) at Malta, and the whole of the Company's staff.

The CHAIRMAN and SECRETARY briefly replied; and the proceedings then closed.

WIGAN CORPORATION GAS SUPPLY.

The Past Year's Working.

The Engineer and Manager of the Wigan Corporation Gas Works (Mr. Joseph Timmins, M.Inst.C.E.) has presented to the Gas Committee his fifteenth annual report, embracing the twelve months ending the 31st of March last. It shows that the quantity of coal and cannel carbonized was 35,669 tons 10 cwt., or 1174 tons 18 cwt. more than in the preceding twelve months. The bulk of gas made was 403,664,000 cubic feet, or 21,439,000 cubic feet more than in 1900-1901—equal to 5·6 per cent.; the amount sold and used for public lighting was 373,672,800 cubic feet, an increase 18,928,000 cubic feet, or 5·36 per cent. The slot-meter consumption was 6,169,800 cubic feet. At the beginning of the year, there were on the register 10,323 consumers by ordinary, and 543 by the above-named meters; making a total of 10,866. At the end of the year, the numbers were 11,096 and 1024—giving an increase of 773 ordinary, or 7·49 per cent., and 481 slot, or 88·58 per cent. The total increase of consumers for the year was 1254, or 11·54 per cent. The number of gas cooking-stoves on the register at the beginning of the year was 1050; at the end, 1447—being an increase of 397, or 37 8 per cent. There were laid in the past financial year 845 new services; and 119 were renewed. The consumption of gas for cooking and heating amounted to 34,692,700 cubic feet, against 31,260,900 cubic feet in the preceding year; while for motive power the quantity used was 17,108,600 cubic feet, compared with 10,042,600 cubic feet. The increase on the previous year for cooking and heating was 3,431,800 cubic feet, equal 10·97 per cent.; and for motive power, 7,066,000 cubic feet, or 70·32 per cent. The gas used for cooking, heating, and motive power represents 13·86 per cent. of the total quantity sold. The cost of coal and cannel was 12s. 8d. per ton, compared with 13s. 3d. in the year 1900-1901. The lowest price paid by the Corporation was in 1898, when they got their raw material for 8s. 5¼d. per ton; but the average from 1887 is 10s. 4·12d. The revenue from residuals last year was 8s. per ton; so that the net cost was 4s. 8d. In 1898, however, it was only 2s. 6¾d. The average revenue from residuals has been 7s. 0·62d.; and the net cost of coal and cannel, 3s. 3·68d.

From the statistical tables accompanying the report, we find that the capital actually invested in the works at the close of the past year was £347,498; being equal to £9 14s. 8d. per ton of coal carbonized, 17s. 2d. per 1000 cubic feet of gas made, and 18s. 7d. per 1000 cubic feet sold. The figures for the preceding year were £344,071, £9 19s. 6d., 18s., and 19s. 4d. The revenue from the sale of gas was £54,901; from residuals, £14,300; and from miscellaneous sources, £1377—total, £70,578, against £72,563 before. The expenditure on the manufacture of gas was £30,289; on distribution, £1805; on rents, rates, and taxes, £3457; on management, £926; and sundry expenses came to £11,212—total, £47,689, against £47,493. The gross profit was £22,888, compared with £25,070. The addition of the balance from the previous year brought up the first-named amount to £36,646; but deducting the interest reduced it to £28,108. The Committee transferred £3661 to pay for the public lighting, placed £5660 to the sinking fund, £13,100 to the general district fund, and £90 to the bad debts account; making a total of £22,511, and leaving a balance of £5597 to be carried forward. The net profit this time last year was £11,107; but the free lighting accounts for £3660 of the difference.

BURY CORPORATION GAS SUPPLY.

A Satisfactory Year's Working.

At the last Monthly Meeting of the Bury Town Council, Mr. L. Fletcher, the Chairman of the Gas Committee, in moving the confirmation of their rates, said he was fortunate in being placed in that position in a year which had been most trying and difficult so far as regarded the gas industry. The Chairman of one of the largest Gas Companies in London had recently told the shareholders that the present was a crisis in the gas industry; and the Chairman of a Gas Committee within 40 miles of Bury had apprised his Council that he had the mournful task of informing the ratepayers that the estimates regarding the gas-works, presented twelve months before, had been falsified, and that, instead of their having a balance to the good, they were £11,000 on the wrong side, and he proposed that 3d. per 1000 cubic feet should be added to the price of gas. In their own immediate neighbourhood, in almost every case losses were reported. The gas-works in Bury were thoroughly up to date, and the Committee were business men who, when they had a good Engineer and Manager (Mr. H. Simmonds), gave him their full confidence, and worked with him in the interests of the borough, so that the best results might be produced from the works. The estimates presented to the Council twelve months ago had been more than realized. The profit looked for was £2059; but that actually realized was £3858, though the interest and sinking fund had been £700 more than in the preceding twelve months. The gas had not diminished in quality. Throughout the year its illuminating power had been, on an average, 18·49 candles; while one of the largest Companies in London had been allowed to reduce theirs from 16 to 14 candles. The leakage had been only 2·7 per cent.; whereas in years past it was generally 6 per cent. The estimate for the coming year (as shown by Mr. Simmonds's report given last week) was that the gas would cost 1s. 11d. per 1000 cubic feet; and they proposed that the price should be 2s. 2d., less 1d. for discount and 2d. share of profits, bringing down the figure to 1s. 11d. It had also been decided, in order to encourage the use of gas for motive power, to charge what would really be 1s. 9d. per 1000 cubic feet for gas used for this purpose. The Committee had not overlooked those who used prepayment meters, but had decided to allow 30 instead of 28 cubic feet for 1d. The great thing was for the Committee to make their productions as cheap as possible; and if they could encourage the use of more gas for motive power, there would be less black smoke. After a brief discussion, the minutes were confirmed.

WEST BROMWICH GAS DEPARTMENT.

An Unsuccessful Year.

The annual report and accounts of the gas undertaking of the West Bromwich Corporation have been issued by the Borough Treasurer and Secretary of the Gas Committee (Mr. T. Hudson). In the twelve months ending March 31, the borrowing powers were increased by £3124, of which £2924 was raised. As the indebtedness was reduced by the last-named sum, the net amount remains unaltered—viz., £180,441. The expenditure on capital account stands at 13d. per 1000 cubic feet of gas sold. The sales of gas continue to increase, although the rate during last year was not so high as in several preceding years. The total for the year on all classes of consumers was 3 per cent.; that on the prepayment meter class being over 5 per cent., while the ordinary consumers showed a decrease of 1½ per cent. On the other hand, the sales of gas for motive power and manufacturing purposes augmented by over 37 per cent. The income from gas sold was £1741 in excess of the previous year. The total income from the prepayment class reached £8457. The total number of consumers of all kinds at the end of the financial year was 10,310—an increase of 168. The total quantity of gas burnt by private consumers and for public lighting was 318,225,800 cubic feet—an increase of 2·85 per cent. The total income from residual products was £5481 below that of the previous year. The total income from all sources was £58,112, compared with £63,477 last year—a reduction of £5365. The total expenditure on the trading account was £48,997, compared with £50,201 last year—a decrease of £1204. While the income is lower by £5365, the expenditure has been reduced to the extent of only £1204. The total manufacturing charges, including materials for carbonizing and enrichment, amount to £36,842 12s.—a decrease of £1248. The total quantity of gas made was 339,167,000 cubic feet—an increase of 11,699,000 cubic feet. The gross profit on the trading account was £9114, against £13,275 for the previous year—a decrease of £4161. The surplus on the year's working is £235, against £4513 before.

The West Hartlepool Gas Company, in conjunction with the Richmond Gas Stove and Meter Company, Limited, have opened a new show-room. A photograph to hand pictures an attractive exterior, and an interior furnished with all kinds of modern gas stoves and appliances for household use. The show-room occupies a prominent position; and it has been a centre of much interest.

The Cannon Iron Foundries, Limited, of Deepfields, Staffs., are issuing an attractive and novel show-card, representing "magic cooking." The "magicians" engaged in the culinary operations are a number of pretty little winged children, who are busily occupied with one of the Company's "Hercules" stoves. The card is a very artistic and effective production; and the design has been registered.

LEEDS GAS-WORKERS DISPUTE.

A Settlement Arrived at.

A satisfactory settlement has at last been amicably arrived at of the long-standing dispute between the Leeds Corporation Gas Committee and their employees. It will be remembered that on the 23rd ult. the Gas Committee decided to offer an advance of 2d. per shift to the men under the present conditions; and a strong hope was expressed that the proposal would be accepted. On the following day, delegates from all over the county attended a meeting of the Yorkshire Council of Gas Workers at the new Trades Hall in Leeds, for the purpose of considering these terms. The delegates discussed the matter at great length, and unanimously agreed to reject the offer of the Gas Committee. Another meeting of the Council was, however, held last week, at which it was decided to accept the proposed 2d. per shift increase for all the sections involved in the application of the Union, and subject to the conditions attached to the previous offer of the Committee. Mr. J. E. Smith, the District Secretary of the Union, communicated the decision of the Council to the Town Clerk (Mr. W. J. Jeeves) and received a reply to the effect that the increase would come into force on the 12th inst.

THE PUBLIC LIGHTING QUESTION AT BRADFORD.

At the Monthly Meeting of the Bradford City Council last Tuesday—the MAYOR (Mr. W. C. Lupton) presiding—a discussion took place on the recommendation of the Finance and General Purposes Committee that a sum of £21,000 should be provided out of the general district rate for the current financial year as the cost of street lighting, on condition that the price of gas should be reduced from 2s. 6d. to 2s. 3d. per 1000 cubic feet. The adoption of the minutes having been moved and seconded,

The MAYOR pointed out that upon the Gas Committee's minutes there was a resolution to the effect that the Gas Committee "are not prepared to accept the offer of the Special Finance Sub-Committee, *re* street lighting, to grant £21,000 out of the general district rate towards the cost of street lighting, subject to the price of gas being reduced from 2s. 6d. to 2s. 3d. per 1000 cubic feet; and that it be a recommendation to the Council to disapprove such recommendation, and in lieu thereof to grant the sum of £28,000 out of the general district rate for cost of street lighting, such amount being the lowest estimated cost thereof." He suggested that the whole subject be dealt with on the minutes of the Finance and General Purposes Committee.

Mr. R. JOHNSON suggested that Mr. Godwin (who, as Deputy-Chairman of the Finance Committee, moved the adoption of the minutes) should withdraw the resolution granting the Committee a definite sum of £21,000 for the cost of street lighting, and substitute such a sum as the City Treasurer should certify as the actual cost price of gas used for the purpose.

Mr. JAMES FREEMAN, the Chairman of the Gas Committee, moved, as an amendment, that the minutes of the Finance and General Purposes Committee be approved, with the exception of the resolution regarding the grant of money to the Gas Committee. He said he had at the last meeting urged that a sum of £28,000 or £29,000 should be granted to the Gas Committee, on the ground that this was the sum actually expended in the lighting of the streets. That resolution, however, did not receive any support; and subsequently, at the meeting of the Finance Committee, it was proposed that, as a compromise, a sum of £21,000 should be granted. On the principle that half-a-loaf was better than no bread, he accepted this proposal; but at the meeting of the Gas Committee, at which he was present, a resolution was carried declining to accept the sum of £21,000 on the conditions attached to it. The figures which had been given by him at a former meeting with respect to the cost of gas had not been, and could not be, contradicted. In explanation of the figure of £17,000, which was the estimated loss up to March 31, 1903, it ought, he said, to be remembered that coal still cost £20,000 more than three years ago, street lighting cost £8000 more, the maintenance of street-mains cost £5000 more, rates and taxes cost £2000 more, sinking fund cost £4000 more, the reduction of the price of gas in the added districts cost £6000, and the outlay on labour and materials was £3000 more—making a total of £48,000. Against this had to be placed the increased revenue from gas to the amount of £18,000; leaving a difference of £30,000. The profit made three years ago was £20,000, so that there was a difference of £10,000. There was also a loss of £12,000 a year on the sale of residuals.

Mr. JOHN ARNOLD seconded the amendment.

Mr. H. H. SPENCER said the balance-sheet showed that the Committee were £30,000 worse off than three years ago; and they wished the Council to give them £55,000 towards this deficiency. They wanted a better explanation of the way this deficiency arose before they consented to do anything of the sort. There was something still more serious which also needed inquiry. For the year ending March 31, 1900, the profit made by the gas-works was £20,500, and for the year ending March 31, 1901, there was a loss of £4100. In 1900, there was allocated in relief of rates out of gas profits £31,000; and in 1901, £20,000, although in that year there was a loss of £4000. What would be thought of the directors of any private company who allocated in dividend £51,000 when they had only made £15,000 profit? If the Gas Committee, in face of a rising market for coal and a falling market for residuals, indulged in such finance, it was a disgrace to the city of Bradford. The time for protest against such a system, however, was when the friends of Mr. Freeman were in power.

Mr. E. R. HARTLEY said the money which was allocated to the relief of rates was profits which had already accumulated. If the Corporation had accepted a resolution which he had submitted in favour of seeking power to buy a coal mine, all this difficulty would have been avoided.

Mr. F. W. JOWETT said the question of the cost of gas for street lighting was a totally different question from the allocation of gas profits in years gone by. Whatever had been done in the direction of allocating gas profits to the relief of rates, had been done with the consent of all sections of the Council. The Council had decided by resolution that, whatever the cost of street lighting, it should be charged to the Finance Committee. Having determined this preliminary question, there could be no possible doubt, in face of the report of the City Treasurer and the Gas Engineer, that the payment should be £28,000.

Mr. JOHNSON suggested that the resolution should read to the effect that £21,000, or such other sum as the City Treasurer might certify as the cost of street lighting, be provided out of the general district rate for the current financial year, on condition that the price of gas be reduced as asked. He was willing to move an amendment to this effect.

Mr. FREEMAN expressed himself willing to accept an alteration of his amendment which would make the amount to be provided subject to the decision of the City Treasurer as to the actual cost of street lighting.

Mr. J. HAVHURST said it was not right to criticize the management of the Gas Committee as to appropriating accumulated profits, for how much of these profits was taken was really decided by the Finance Committee. Whether the Gas Committee had been wrong or not, it would be still more wrong for the Council to adopt the policy of Mr. Spencer in insisting that, under existing circumstances, the Gas Committee should be obliged to reduce the price of gas from 2s. 6d. to 2s. 3d. per 1000 cubic feet.

Mr. FREEMAN remarked that the cost of street lighting was £28,000; and if the Gas Committee had to reduce the price of gas by 3d., there would be a deficit of £17,000.

Mr. GODWIN, in reply, said that the sum of £21,000 had been estimated as the cost of the street lighting. It was obvious that if the Gas Committee received this sum there must be a reduction in the price of gas to the consumers whose rates were being raised.

On being put to the vote, both amendments were defeated.

THE DUNDEE CORPORATION GAS-WORKS.

Mr. W. Foulis's Recommendations.

Mr. William Foulis, the Gas Engineer to the Corporation of Glasgow, paid a visit to Dundee on Saturday, the 7th inst., for the purpose of inspecting the Corporation gas works there and advising the Gas Committee as to their condition. The "Dundee Advertiser" gives the following account of the visit.

During the reconstruction of the gas-works, Mr. Foulis, though not Consulting Engineer of the Committee, has been in their confidence; and when it was seen that the expectations formed a year ago were not to be realized, they naturally appealed to him to tell them what was wrong. Mr. Foulis readily offered to give them all the help he could, and agreed to visit the works in order to ascertain if they had been properly constructed. He, however, asked to be furnished beforehand with a number of documents referring to the department, principally in connection with the finance, in order that he might make himself acquainted with the nature of the difficulties into which the Committee believed they had landed. These were sent, and when he came to the city he was able to devote his whole time to an examination of the works.

He arrived in Dundee about half-past ten on Saturday forenoon, and was received by ex-Provost Ballingall, the Convener of the Gas Committee, who took him to the Town House. There he was met by Lord Provost Hunter, Bailie Stevenson, Treasurer Ritchie, and Councillors High and Speed. The party drove to the works, where they were joined by Mr. W. M'Crae, the Manager. Ex-Provost Ballingall explained the position of affairs, and said their chief concern was with the new retorts, from which they had not obtained the results anticipated. As Mr. Foulis had seen from the documents, the results in the shape of gas from the retorts had been considerably below the analysis. Besides, the retorts had cracked in several places, and the higher benches took longer to fire than the lower ones. The company proceeded to the retorts; and Mr. Foulis made a thorough examination of them. He saw both those which were being worked, and the others which were in course of reconstruction. He inquired of the Manager and the foreman bricklayer as to their design and construction, and, so far as he could, he tested them working. With regard to the design of the retorts, he said it was one he would not have used, and it was not according to his plans. But nearly every gas engineer had a style of retort of his own, and they found it advisable to use the kind they were accustomed to, if they got good results. He was assured by Mr. M'Crae that he had worked that style of retort for fourteen years, and had always been satisfied; and he therefore thought Mr. M'Crae might be right in continuing it. It was all, however, a matter of experience. But he had got satisfactory results from his own style of retort; and he saw no reason why the same results should not be got in Dundee from the same design. Regarding the setting of twelve retorts, he said he approved of it, as he thought it was an economy of heating to have twelve retorts in one bed instead of eight. If there were proper regenerators, the heat should go round them all. He believed in baffles being put in, as they distributed the heat, and no doubt part of the difficulty was caused by their absence. The Convener asked if it would cost £2000 to put in baffles and make the retorts as he suggested; and Mr. Foulis replied that he did not think it would cost so much. If the work were started at once, it could be done before the winter, during the long summer days, so that no time would be lost. He did not think the workmanship of the retort bench was as good as it should have been. In laying the bricks the band had not been broken. He recommended the Manager to get small bricks, and, in constructing the retorts, to work the bricks as close together as possible, and fix them with fire-clay. If the foreman bricklayer liked to go to the Glasgow Gas-Works, he would see how the laying had been done there. He also recommended the Analyst to direct his attention to the gases which escaped up the flues, as there was heated gas going up the chimney which might be taken back to assist combustion. That was a matter which was very important, and he would like to know the result of the analysis. If the reconstruction of the retort-

settings were carried out as he suggested, he had no doubt they would give satisfaction. But that was a matter which required great attention. When he reconstructed the Glasgow Gas-Works, he practically lived in the works all the time, and saw that everything was done as he thought it should be, as he knew that a slight deviation might have serious results. The generators and retorts required to be all renewed; and Mr. M'Crae should not rest till he got them right. He knew that was not an easy matter, and it took him nearly two years, working night and day when necessary, to get his own ones to please him. If the reconstruction were carried out in this way, they would find that their difficulties, caused by the difference in the time of carbonizing in the higher and lower retorts, and also the smoke nuisance to a large extent, would disappear.

When taken into the Analyst's department, he remarked that it was well equipped, and added that he did not know if there was as good a one in Glasgow. As for the relative advantages of mechanical and hand stoking so far as the production of gas per ton of coal was concerned, he said, from his experience, mechanical stoking produced quite as good results as hand stoking; and he did not agree with Mr. M'Crae that the advantage was on the side of hand stoking. Besides, mechanical stoking was now generally in use in large works, and had great advantages from the point of view of saving labour. In reply to a question by Mr. High, Mr. Foulis said the reason it took eight hours to carbonize the coal in the six top settings of the ovens, as compared with four hours for the lower settings, was owing to the absence of baffles to carry the flames up to the top settings. Dealing with the price of gas, he said he thought it was a mistake to reduce the price a year ago, considering their heavy liabilities. He did not think they sufficiently allowed for the rise in the price of coal. As for this year, he strongly advised them not to reduce the price. Asked the reason the retorts had cracked, he replied that if they were started too soon, that would account for the cracking, and also the fact that the bricks had not been bound properly. In making up the accounts, he advised them to adopt the Board of Trade model, as they would then be able to compare their accounts with the accounts of other works, and see how they stood. On the whole, his general opinion was that they had not much to complain about. They had been reconstructing huge works, and that always involved a large amount of unforeseen expenditure. The fact that they had been carbonizing coal at a reduction of 1s. 4d. per ton since the new system was introduced, showed that they might yet expect satisfactory results. He expressed his approval of the coke gantry, and explained that they had been getting a higher quality of coke than was produced in Glasgow. On the whole, his opinion was that it was useless for them to expect good results from the works to begin with. Much of their expenditure would not recur, but when everything was completed he thought they might hope to get value for their money. Asked by Mr. High to give his opinion on the management, he replied that that was hardly a question he could answer. Mr. Foulis spent altogether two hours in the works; and at the conclusion of the visit, the company lunched together. There was no meeting of the Council after Mr. Foulis left.

As the result of his visit, the members of the Committee felt somewhat reassured; and one of them remarked that after all the works were not so black as they had been painted. The general opinion seemed to be that the suggestions made by Mr. Foulis should be carried out as rapidly as possible; that the price of gas should be maintained at the present figure; and that they should wait for another year before making any drastic changes, by which time they would have an opportunity of judging what the result of the reconstruction was likely to be. It is understood that Mr. Foulis will not submit a written report of his visit, but it is probable that a meeting of the Gas Committee will be called, when the Convener will explain the changes Mr. Foulis suggested should be made, and ask the necessary consent for reconstructing the retorts. When the result of Mr. Foulis's visit became known among the town councillors on Saturday, the satisfaction was by no means universal, especially the recommendation that the price of gas should not be reduced. It appears that Mr. High was anxious to put a number of questions to Mr. Foulis, but was dissuaded by the other members of the Committee present, and, seeing that his curiosity was not appreciated, he left the table at which the company were discussing the general affairs of the undertaking. When the whole matter is being considered by the Committee, the lack of a written report may be commented on; and the opinion was freely expressed on Saturday evening that the ratepayers would not readily accept Mr. Foulis's optimistic opinions. In justification of Mr. Foulis's views that the price of gas should not have been reduced a year ago, it is explained that he pointed out to those who met him that at that time Glasgow had a deficit of £60,000, and they arranged to wipe it off in three years. He held that the price of coal should always rule the price of gas, after making full provision for sinking fund and interest and other fixed charges. In regard to Mr. Foulis's remarks anent the Analyst's results, it is pointed out that the charge of coal in the Analyst's retort is 2 cwt.; while in ordinary retorts it is 3 cwt. So that it is thought the difference in the results should not be very much, especially as they used to get as good results from the one as from the other.

A Joint Meeting of the Finance and Gas Committees of the Dundee Town Council was held on Tuesday last, for the purpose of further considering the estimates of the Gas Department for the current year, and making a recommendation to the Town Council regarding the price of gas.

Treasurer RITCHIE (who presided) explained that the previous meeting had been adjourned till that day in order that the members might have the benefit of Mr. Foulis's views on the gas-works.

Mr. NAIRN suggested that the officials should be asked to retire. He stated that he was not a member of the Gas Committee, and he therefore reserved his right of action at the Council, whatever decision that meeting might come to.

The officials accordingly left the meeting.

Mr. BALLINGALL, the Convener of the Gas Committee, said there was no doubt that the real cause that had led up to the present unsatisfactory state of matters at the gas-works was the defective

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 1686.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 11	10½	Alliance & Dublin 10 p.c.	18—19	..	5 10 6
100,000	10	"	7⅞	Do. 7 p.c.	13—14	..	5 7 2
300,000	100	Jan. 2	5	Australian 5 p.c. Deb.	100—102	..	4 18 0
200,000	5	May 14	6½	Bombay, Ltd.	6—6¼	..	5 0 0
40,000	5	"	6¼	Do. New, £4 paid	4¼—4⅜	..	5 9 5
380,000	Stk.	Feb. 13	12	Brentford Consolidated	255—260	..	4 12 4
270,000	"	"	9	Do. New	188—193	..	4 13 3
50,000	"	"	5	Do. 5 p.c. Pref.	128—133	..	3 15 2
206,250	"	June 12	4	Do. 4 p.c. Deb.	111—114*	+1	3 10 2
220,000	Stk.	Mar. 13	10	Brighton & Hove Orig.	205—210	..	4 15 3
246,320	"	"	7	Do. A. Ord. Stk.	148—153	..	4 11 6
420,000	20	Apl. 11	10	British	40½—41½	..	4 16 5
50,000	10	Feb. 13	12	Bromley, Ord. 10 p.c.	23—25	..	4 16 0
82,850	10	"	9	Do. 7 p.c.	18—20	..	4 10 0
500,000	10	May 14	6	Buenos Ayres (New) Ltd.	9½—10⅜	..	5 14 3
220,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb.	94—97	..	4 2 6
150,000	20	Mar. 13	8¼	Cagliari, Ltd.	21—23	..	7 3 6
100,000	10	June 12	10	Cape Town & Dis., Ltd.	15—16*	+⅛	6 5 0
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	54—56	..	5 7 2
550,000	Stk.	Apl. 11	12	Commercial Old Stock	265—270	+1	4 8 11
236,425	"	"	9	Do. New do.	205—210	..	4 5 9
238,237	"	June 12	4½	Do. 4½ p.c. Deb.	130—134*	+2	3 7 2
800,000	Stk.	May 28	8	Continental Union, Ltd.	137—142	+2	5 12 8
200,000	"	"	7	Do. 7 p.c. Pref.	150—155	..	4 10 4
575,000	Stk.	Feb. 27	5	Crystal Palace Ord. 5 p.c.	120—125	..	4 0 0
60,000	"	"	5	Do. 5 p.c. Pref.	122—127	..	3 18 9
486,090	10	Jan. 30	10½	European, Ltd.	18½—19½	..	5 7 8
354,060	10	"	10⅜	Do. £7 10s. paid	13½—14½	..	5 8 8
15,243,200	Stk.	Feb. 13	4 1/16	Gas-light and Coke	4 p.c. Ord.	94—96	+1	4 11 8
2,600,000	"	"	3½		3½ p.c. max.	88—90	..	3 17 9
3,799,735	"	"	4		4 p.c. Con. Pref.	107—110	..	3 12 9
4,193,975	"	June 12	3		3 p.c. Con. Deb.	91—93*	+1⅛	3 4 6
70,000	10	Nov. 13	8	Hongkong & China, Ltd.	13—14	..	5 14 4
3,800,000	Stk.	May 14	10	Imperial Continental	204—207	−1	4 16 7
473,600	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	100—102	..	3 8 8
561,000	Stk.	Feb. 27	10	Liverpool United A	220—222	+2	4 10 1
718,100	"	"	7	Do. do. B	166—168	..	4 3 4
306,083	"	Dec. 30	4	Do. do. Deb. Stk.	118—120	..	3 6 8
75,000	5	June 12	5	Malta & Medn., Ltd.	4¼—4⅜*	..	5 5 3
560,000	100	Apl. 1	5	Met. of Melbourne	5 p.c. Deb.	100—110	..	4 10 11
250,000	100	"	4½		4½ p.c. Deb.	103—105	..	4 5 9
541,920	20	June 12	5½	Monte Video, Ltd.		9—10*	..	7 0 0
1,595,892	Stk.	Feb. 21	4⅝	Newc'tle & G'tesh'd Con.		105—107	..	4 1 9
346,855	Stk.	Dec. 27	3½	Do. 3½ p.c. Deb.		100—102	..	3 8 8
150,000	5	May 28	8	Oriental, Ltd.		7—7½	..	5 6 8
135,060	4½	"	8	Do.		6—6⅛	..	5 10 9
15,000	1	"	8	Do.		1⅛—1⅜	..	4 11 5
60,000	5	Mar. 13	7	Ottoman, Ltd.		6⅛—6⅜	..	5 3 8

* Ex. div.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
851,070	10	Apl. 25	7	River Plate Ord.	10—10⅜	..	6 13 4
250,000	Stk.	Dec 30	4	Do. 4 p.c. Deb.	95—98	..	4 1 8
250,000	10	Mar. 26	8	San Paulo, Ltd.	11⅜—12½	..	6 8 0
135,000	Stk.	Mar. 13	10	Sheffield A	239—241	..	4 3 0
209,984	"	"	10	Do. B	238—240	..	4 3 4
523,498	"	"	10	Do. C	237—239	..	4 3 8
5,850,000	Stk.	Feb. 13	5	South Met., 4 p.c. Ord.	122—125	+2	4 0 0
1,627,965	"	Jan. 16	3	Do. 3 p.c. Deb.	93—95	..	3 3 2
380,940	Stk.	May 14	5	Southampton Ord.	102—106	..	4 14 4
70,825	"	Jan. 16	4	Do. 4 p.c. Deb.	100—103	..	3 17 8
120,000	Stk.	Feb. 27	5½	Tottenham and Edmonton	A. 5 p.c.	120—125	..	4 8 0
260,520	"	"	4		B. 3½ p.c.	95—100	..	4 0 0
182,380	10	Jan. 16	5	Tuscan, Ltd.		7—8	..	6 5 0
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.		97—100	..	5 0 0
230,000	5	Mar. 13	9	West Ham, 10 p.c.		10—11	+1	4 1 10
172,000	10	"	6	Do. 7 p.c.		13—14	..	4 5 8
140,900	Stk.	Dec. 30	4	Do. 4 p.c. Deb.		105—110	..	3 12 9
				WATER COMPANIES.			
780,599	Stk.	Dec. 30	11⅓	Chelsea, Ord.		305—315	..	3 13 0
150,000	"	"	5	Do. 5 p.c. Pref.		155—160	..	3 2 6
160,000	"	"	4½	Do. 4½ p.c. Pref. '75		140—145	..	3 2 1
175,785	"	Mar. 26	4½	Do. 4½ p.c. Deb.		140—145	..	3 2 1
1,720,560	Stk.	Mar. 26	8	East London, Ord.		210—215	+2	3 14 5
654,740	"	June 12	4½	Do. 4½ p.c. Deb.		142—147*	+1½	3 1 3
1,018,046	"	"	3	Do. 3 p.c. Deb.		96—98*	+½	3 1 3
700,000	50		8	Grand Junction	10 p.c. max.	112—117*	+1	3 8 5
310,000	Stk.	Mar. 26	4		4 p.c. Deb.	127—130	..	3 1 7
708,000	Stk.	Feb. 13	16	Kent		295—305	..	5 4 11
160,000	"	"	7	Do. New, 7 p.c. max.		200—210	..	3 6 8
1,043,800	100	Dec. 30	10½	Lambeth, 10 p.c. max.		295—305	+2½	3 8 10
406,200	100	"	8	Do. 7½ p.c. max.		210—220	..	3 12 9
350,000	Stk.	Mar. 26	4	Do. 4 p.c. Deb.		125—130	..	3 1 7
500,000	100	Feb. 13	12 9/10	New River, New Shares		405—415	..	3 1 8
1,000,000	Stk.	Jan. 30	4	Do. 4 p.c. Deb.		127—132	..	3 0 7
902,300	Stk.	June 12	7	South-wark and Vauxhall	Ord.	188—193*	−1½	3 12 6
126,500	100	"	7		7½ p.c. max.	180—185*	−1½	3 15 8
489,200	Stk.	"	5		5 p.c. Pref.	152—157*	+1½	3 3 8
1,019,585	"	Apl. 11	4		4 p.c. A Deb.	125—130	..	3 1 7
1,155,066	Stk.	June 12	10	West Middlesex		275—285*	−5	3 10 2
200,000	"	"	4½	Do. 4½ p.c. Deb.		139—144*	+1½	3 2 6
200,000	"	Mar. 13	3	Do. 3 p.c. Deb.		95—97	..	3 1 10

* Ex. div.

construction of the new retorts. There was no necessity for it, as Mr. M'Crae had had ample opportunities for obtaining the necessary information regarding them. Through the kindness of Mr. Foulis, Mr. M'Crae had ample opportunity of seeing how the gas-works in Glasgow were constructed, and he also had access to all the plans Mr. Foulis had used. But, instead of taking advantage of these facilities, Mr. M'Crae had carried out his own views. The Gas Committee were of opinion that the works were being planned and constructed on the Glasgow model. It was not till the works were pretty well advanced, that he found with surprise that they were not being constructed according to Mr. Foulis's plans, but according to Mr. M'Crae's own plans. For his own sake and for the sake of Mr. M'Crae, he protested against that course of procedure. It might be stated as one very pregnant fact, Mr. Ballingall continued, that the Manager's hours would be nearly correctly stated at from 10 a.m. to 12.30 p.m., and from 2.30 to 5 p.m.—six hours a day in the works under construction. Mr. Foulis was in his works on Sundays and Saturdays while they were under construction; and no Manager could afford to be long away from the place at such a critical time. On the question of management, it was suggested that a vote by ballot should be taken.

Lord Provost HUNTER thought it had not been properly seen to that the banding was of a sufficient character to give the retorts a chance of working effectively.

Mr. NAIRN said if the brickwork had expanded in such a disastrous way, it could only have been caused by commencing to work the retorts too early, and for that the Manager was surely solely responsible. No one could expect the Convener or members of the Committee to tell him when to start the retorts.

Mr. BROWNLEE asked how it came about that the old retorts of fourteen years ago gave good results, while the new ones, built on the same model, were so defective.

Bailie STEVENSON explained that Mr. Foulis quite approved of the old ones, and stated there was no reason why the new ones should not be built on that model. But, as a matter of fact, Mr. M'Crae had not built the new ones on the old model, but had made what he considered an improvement on them.

Lord Provost HUNTER remarked that Mr. Foulis told them they could get as good results from mechanical stoking as from hand stoking, if properly done. The smoke nuisance complained of could only be caused by defective carbonization; and it was probably with the view of remedying this that the retorts had been used too early.

Mr. BROWNLEE deprecated a vote by ballot, as he thought they should all express their convictions openly. From the remarks that had been made—and he had no reason to doubt them—there appeared to be incapacity somewhere. But he thought it would be premature for them to decide on the matter that day. It was a very important question, and they should take time to consider it.

It was suggested that the question of the management might be continued till after the annual meeting of the Gas Commission, when it could be dealt with if necessary. This was agreed to. It was stated that notes were taken of Mr. Foulis's remarks regarding the works, and it was advisable that the members should have an opportunity of reading them. Probably they would shed a new light on the matter.

It was afterwards agreed to recommend the adoption by the Council of the estimates as drawn up, including the fixing of the price of gas at 3s. 6d. per 1000 cubic feet. The meeting for the disposal of the estimates and the fixing of the price of gas takes place on the 18th inst.

SALES OF STOCKS AND SHARES.

Last Tuesday, Messrs. J. B. & B. Leach sold by auction, at the offices of the Huyton District Council, Liverpool, a number of shares in the Huyton and Roby Gas Company, to close a trust estate, with the following results: Lot 1, consisting of several original £10 shares (fully paid), upon which a maximum dividend of 10 per cent. has always been paid, realized £19 per share. Lots 2 and 3, consisting of similar shares, fetched £18 10s. per share. Lots 4 to 7, comprising new £10 shares, fully paid, upon which a maximum dividend of 7 per cent. has always been paid, realized £13 5s. per share. Lots 8 and 9, consisting of similar shares on which £9 has been paid, and carrying a maximum dividend of 7 per cent., were disposed of at £11 5s. and £12 per share. The following day, Mr. J. W. Crosby offered for sale, at the offices of the Hartlepool Gas and Water Company, £10,000 of the Company's 5 per cent. maximum ordinary stock, carrying dividend as from the 9th prox. It was put up in £100 lots, which fetched from £125 2s. 6d. to £125 10s. each. On Thursday, Messrs. Tootell and Sons sold £830 of ordinary stock of the Maidstone Gas Company. Four lots of £100 of stock went at £196 each; one lot of £50 sold for £96, three lots at £95, and four at £94; while one lot of £30 fetched £53. A bid of £51 was accepted for £69 of 3 per cent. debenture stock of the Company. The next day, Messrs. Woods and Co. carried out the instructions they had received from the Directors of the Northampton Gas Company to offer for public competition a further issue of "E" shares, of £20 each, under the provisions of their Act of 1887. They were put up in lots of five each, and the bidding for them was very brisk. The first lot was sold at £29 per share; but after this there was a steady advance, and all prices were given between £29 and £30 15s. The total result of the sale was £11,118 12s. 6d.; the average price per share being £30 5s., which was regarded as eminently satisfactory. Afterwards eight "B" shares were offered, and fetched £17 2s. 6d. each. The tenders for the £30,000 of 3½ per cent. debenture stock of the Newcastle and Gateshead Gas Company recently offered for sale by the Directors, as announced in our advertisement columns, were opened on Monday last week. It was found that the stock had been fully applied for, at prices ranging from £100 up to £102. A sale by tender of the Walker and Wallsend Union Gas Company's consolidated stock to realize £14,476 12s. 6d., inclusive of premiums, has just been held. It was all allotted at prices ranging from £190 to £200 per £100 of stock.

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ERECTORS OF GAS-WORKS.
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SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held at the Offices, Southwark Bridge Road, last Tuesday—Alderman Sir HENRY E. KNIGHT in the chair.

The SECRETARY (Mr. Montague Watts) having read the notice calling the meeting,

The CHAIRMAN, in moving the adoption of the report and accounts, said that, as had been the case now for many years, the business of the Company was in a very prosperous condition. Except for circumstances over which the Directors had no control—such as a very severe winter, an increase in the price of coal, or some other extraordinary feature—it had been his good fortune, on behalf of his colleagues, to place before the proprietors each time they had met a satisfactory statement of accounts, showing a steady increase in the prosperity of the undertaking. There were not many points in the accounts to which he need particularly call attention on that occasion. Under the head of "maintenance," there had been an increase of £4782 in the charges for the past half year as compared with those for the six months ended March 31, 1901. This was the net increase in these charges after allowing for all items of increase and decrease. The rates and taxes were higher than they were for the corresponding period of the previous year by £6108. There was not only a continued advance in the assessments at the quinquennial valuation of the Metropolis, but the rate per cent. in the different parishes had also constantly risen. He had had a few details taken out, and he found that the half-year's rate in Battersea had increased, as compared with March, 1901, from 3s. 8d. to 4s. in the pound; in Bermondsey, from 4s. 2½d. to 4s. 4d.; in Camberwell, from 3s. 8d. to 3s. 10d.; in Clapham, from 3s. 4d. to 3s. 7d.; and in Hampton, from 2s. 11d. to 3s. 3d. The quinquennial rise in the assessments was enormous; but the increased percentage also was continually going on in the parishes, until in the past half year alone it made a difference of £6108 to the Company. Against this, he was glad to state that a saving of no less than £1578 had been effected in the pumping and engine charges, in spite of the fact that an increased quantity of water had been pumped into the district. The saving was mainly to be attributed to the very material reduction in the price of coal. The cost of pumping in the half year was £3 3s. 5d. per million gallons, compared with £3 10s. 6d. in the six months ending in March, 1901. Under the heading of "management," there was no particular item to which he need call attention, except that the amount of the sinking fund paid to the City Chamberlain in the past six months was £1246, against £1063 in the corresponding period of last year. After allowing for all the decreases and increases, the total addition to the maintenance and management expenses for the past half year was £4509. On the other side of the account, it was highly gratifying for him to be able to call the attention of the proprietors to the very satisfactory advance in the water-rental, which was, after all, the test of the prosperity of the Company. There had been an improvement of £6187 in this respect, of which, however, £3315 had been received from the East London Company. The normal increase in the Company's own regular business for the half year had thus been £2872, which was exceedingly satisfactory, especially as it had arisen in what was called the bad half year, and it, in fact, represented a considerable improvement when the present half-year's result was brought in, and the year was dealt with as a whole. There were other items which had to be taken into account in arriving at the amount which the Directors were finally able to add to the sum of profits transferred to dividend and interest account; but allowing for all these items *pro* and *con*, they were enabled to transfer £69,500 to the dividend and interest account, or £1066 in excess of the amount carried to that account a year ago. The net increase in the income, after discharging all liabilities, was £5075; and provision for losses had been made for an amount £500 less than the Directors had thought it necessary to provide before. This gave a total improvement of £5575. Deducting from this the net augmentation in the expenditure, the increase in the amount of profits transferred was, as he had said, £1066. The balance available for distribution was £37,397, or £5641 more than the sum shown a year previously. This was very gratifying; and the Directors recommended a dividend of 7 per cent. per annum, which would leave a balance of about £1300 to carry forward. The whole of the report was exceedingly satisfactory, except the paragraph relating to the London Water Bill. With regard to this Bill, he could not say things were looking so favourable as he could wish. He had never before met with anything like the difficulties which they had recently had to contend with; and he had never experienced—and he did not think that anyone else had—such conditions as those under which the Directors of the Water Companies had had to contend for the protection of the Companies' interests. There were these most peculiar circumstances: They did not want to sell their property, but there was a party—the Government—who sought to buy it. That party proposed their own terms; they appointed a Committee of both Houses of Parliament to consider and lay down the principles and conditions under which the concerns were to be purchased; they appointed a Chairman of that Committee; and they appointed the Arbitrators before whom the Directors were to plead the Companies' cause. He made no remark on these circumstances, which he mentioned so that the proprietors might possibly appreciate to some extent the difficulties under which the Directors had had to contend. They had, however, persevered, and had been successful in a few matters, though not to the extent that they had hoped, and as he thought that they ought to have been from the evidence placed by them before the Committee and the arguments of their Counsel. They had, at any rate, succeeded in getting altered the extraordinary proposition that had been made of taking over the whole of their assets, their books, and their means, on an "appointed day," which was fixed at a period when it would have been utterly impossible for the purchasing party to have ascertained the value of the property they wanted to buy. It had been proposed to take all their properties from them, and to leave them to prove their case and to get paid as best they could. However, by the modifications which had been made, the appointed day would in all

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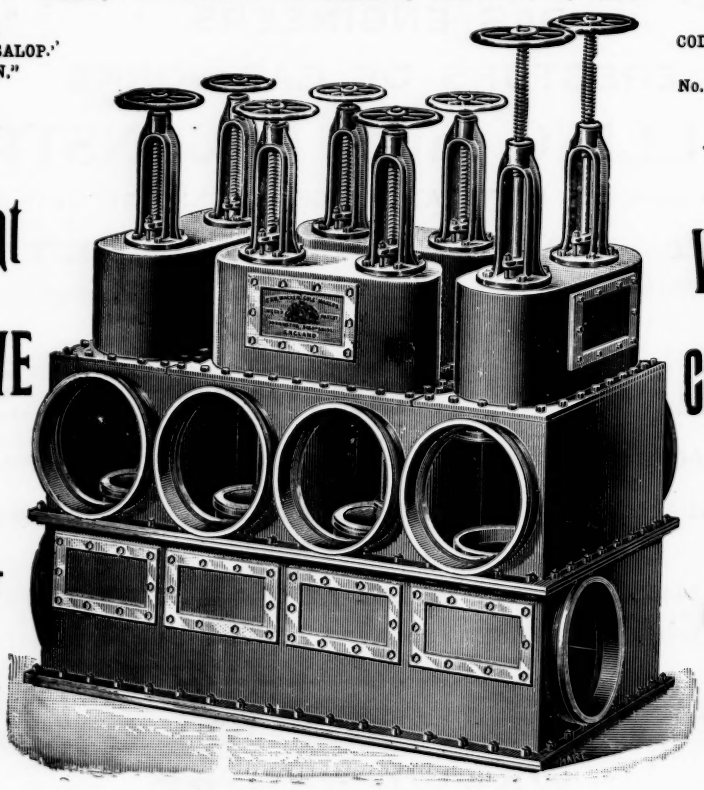

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probability be a day after which the arbitration as to the value of the undertakings would have been determined, and the price to be paid would have been settled. It had been thought that the Water Companies would endeavour to delay the arbitration. He did not know where such an idea could have originated, because it was manifestly to the interest of the Companies to get the arbitration settled as speedily as possible, and they would endeavour to do so. Upon one point he heartily congratulated the inhabitants of the Metropolis—namely, on the fact that a Water Board had been established, and that they had thus been spared the terrible consequences that would have ensued had they been handed over to the tender mercies of the London County Council. They knew what extravagances that body would have indulged in. Untold millions would have been spent by them in bringing water from Wales—a measure proved before Lord Balfour's Commission to be utterly unnecessary, there being ample water at our doors if care were taken to store it, as the Water Companies were doing. Though the Water Board was not constituted on quite what he ventured to think were the best and most workable lines, yet it would, at any rate, be a body that would devote its attention to the one subject; and if those composing it were only well advised, and were able to comprehend the importance of the business they would have to deal with, the inhabitants might possibly have a supply of water in the Metropolitan area as good and as ample as it had been under the management of the Companies. He did not think it would be long before the Bill got out of Committee, and was reported to the House. There would then be another opportunity of dealing with certain matters which the Directors considered were not satisfactory. For his own part, however, he thought it was desirable that the question should be settled, there having been agitation long enough in connection with it.

Mr. C. M. VIALLS seconded the motion, and it was carried.

Resolutions were afterwards passed declaring dividends at the rates of 5 per cent. per annum on the preference stock and 7 per cent. per annum on the ordinary stock and class "D" shares.

On Monday afternoon last week, an exhibition of "Eureka" gas-cookers was opened in the Oddfellows' Hall, Ashton-under-Lyne, by John Wright and Eagle Range, Limited. It remained open till Friday; cooking lectures being delivered twice daily by Miss Ella Lamont There was a large attendance of visitors. On the following day, an exhibition of gas-cookers, gas-fires, and other appliances, was opened in the Public Hall, Arbroath. The exhibits were supplied by the Richmond Gas Stove and Meter Company, Limited, and Messrs. Fletcher, Russell, and Co., Limited. Provost Grant performed the opening ceremony, which was attended by a large number of ladies. In the evening, Mr. A. C. Young, the Corporation Gas Manager, discoursed on the manufacture, use, and misuse of gas. Mrs. Middleton gave cookery lectures twice daily. An attractive feature of the exhibition was a display of the Keith high-pressure system of gas lighting.

GRAND JUNCTION WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held at the offices, No. 65, South Molton Street, W., last Wednesday—Mr. FREDERICK TENDRON, F.G.S., in the chair.

The SECRETARY (Mr. J. Goodwin) read the notice convening the meeting; and other formal business having been disposed of,

The CHAIRMAN proposed the adoption of the report and accounts. The latter must, he said, have given great satisfaction to the proprietors, if they had taken the trouble to compare the figures with those for the corresponding period of 1901. The key to the whole position in a water company was continual progress in its rental; and their own rental increased in the period under review by no less than £4724. This was a normal advance; and it was very satisfactory to see that they had gone on half year after half year continually showing an improvement. There must necessarily be an increase in the expenditure; but in this respect the comparison was very favourable. The result of the half-year's working was to show—for the first time, he thought, in their history—that they were practically a 10 per cent. Company. They earned over 5 per cent. in the half year, putting aside the expenditure on account of the Staines reservoirs. Referring to the London Water Bill, he reminded the shareholders that at the last general meeting he stated that if the measure should be on the lines of the notices which had appeared in connection with it, it would be strenuously opposed by all the Metropolitan Water Companies. He regretted to state that the Bill was on those lines, and the clauses were, in the Directors' opinion, most unjust for dealing with property such as that of the Companies. The key to the Bill was in appointing an arbitrary Committee with powers which were perfectly uncontrolled, and without any instructions in the first instance as to precedents that were to be followed by that Committee. The usual course in a lands clauses arbitration was that each side should appoint an arbitrator and the arbitrator an umpire. This was fair to both parties; and as it had been in operation for many years, precedents had been established which were usually followed, and by which, on the whole, satisfaction had been given in the numerous instances in which these clauses had come into operation. The Companies had the best evidence to show that this course was fair and desirable; but the Committee disregarded it, and the only improvement which could be obtained was that if a vacancy should occur, the appointment should be filled up by the Lord Chief Justice instead of by the Local Government Board. The next matter in which an amendment was effected was that the arbitrators should name the sum in cash that was to be paid to the Companies, and that the latter should have the power to claim to be paid in cash. If a provision of this kind had not been introduced, the Companies would have been entirely in the hands of the Arbitrators, not only to fix the amount of the compensation, but also the value at which the water stock should be apportioned among the proprietors. If the price of this stock was put higher than the Directors thought it should be, they would now have the power to recommend the proprietors to take

CARBURETTED WATER-GAS APPARATUS

Merrifield—Westcott—Pearson Patents.

The Economical Gas Apparatus Construction Co., Ld.

W. H. PEARSON, Chairman.
W. H. PEARSON, Junr., Deputy-Chairman.
J. T. WESTCOTT, M.E., Manager.
L. L. MERRIFIELD, M.Inst.M.E., Engineer.

London Offices: 19, ABINGDON STREET, WESTMINSTER, S.W.
American Offices: TORONTO. TELEGRAPHIC ADDRESS: "CARBURETED, LONDON."

CARBURETTED WATER-GAS ENGINEERS.

The above Company have erected since 1893, or are now erecting, their Universal Type of Carburetted Water-Gas Plant at the following Gas-Works:-

	Cubic Feet Daily.
BLACKBURN	1,250,000
WINDSOR ST. WORKS, BIRMINGHAM	2,000,000
SALTLEY WORKS, BIRMINGHAM	2,000,000
COLCHESTER	300,000
BIRKENHEAD.	2,250,000
SWINDON (New Swindon Gas Co.)	120,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000
WINDSOR ST., BIRMINGHAM (Second Contract)	2,000,000
HALIFAX	1,000,000
TORONTO	250,000
OTTAWA.	250,000
LINDSAY (Remodelled)	125,000
MONTREAL	500,000
TORONTO (Second Contract; Remodelled)	2,000,000
BELLEVILLE.	250,000
OTTAWA (Second Contract)	250,000
BRANTFORD (Remodelled)	200,000
ST. CATHERINES (Remodelled)	250,000
KINGSTON, PA.	125,000
PETERBOROUGH, ONT.	250,000
WILKESBARRE, PA.	750,000
ST. CATHERINES (Second Contract)	250,000
BUFFALO, N.Y.	2,000,000
WINNIPEG, MAN.	500,000
COLCHESTER (Second Contract)	300,000

	Cubic Feet Daily.
YORK	750,000
ROCHESTER	500,000
KINGSTON, ONT.	300,000
CRYSTAL PALACE DISTRICT	2,000,000
DULUTH, MINN.	300,000
CATERHAM	150,000
LEICESTER	2,000,000
ENSCHEDE (HOLLAND)	150,000
BUENOS AYRES (RIVER PLATE CO.)	700,000
BURNLEY	1,500,000
KINGSTON-ON-THAMES	1,750,000
ACCRINGTON	500,000
TONBRIDGE	300,000
STRETFORD	500,000
OLDBURY	300,000
TODMORDEN	500,000
SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
YORK (Second Contract)	750,000
ROCHESTER (Second Contract)	500,000
NEWPORT (MON.)	250,000
TOKIO, JAPAN.	1,000,000
PERNAMBUCO (Brazil)	125,000
MALTON	150,000
DULUTH, MINN. (Second Contract)	300,000

Complete Gas-Works at NELSON, BRITISH COLUMBIA.

LEEDS, 1,800,000 Cub. Ft. SMETHWICK, 500,000 Cub. Ft. LEICESTER (2nd Cont.) 1,000,000 Cub. Ft.
GRAVESEND, 300,000 C. Ft. BROCKVILLE (ONT.) 250,000 C. Ft. NEWPORT, MON. (2nd Cont.), 250,000 C. Ft.

cash. Again, with regard to the debenture stockholders, instead of their being compelled to take this stock redeemable in twenty years, it could not now be redeemed before sixty years. A point on which the Companies had felt most acutely was the period at which they should part with their property, their officers, and really with all control. The date was at first put at Dec. 31 next. As the Bill could not possibly be passed through Parliament before next August, and as the Directors found by the evidence that nine months would probably elapse before the Arbitrators could commence business, all the Companies' property would have passed out of their hands before even the business of arbitration commenced. This was a monstrous proposal. The period had, however, been extended to Dec. 25, 1903. If it was now too late as far as the Committee was concerned, he hoped that in Parliament Mr. Long would meet the earnest desire of the Companies in regard to the question of further extension. What they wanted was for the Arbitrators to have power to extend the period named until their award had been given. If the Government said that the Companies were to place implicit confidence in the Arbitrators, let the Government show that they had a little confidence themselves in the Arbitrators, who were their own nominees. One of the grossest acts of injustice had been the proposal in the Bill to take all the cash of the Companies. There had been a great deal of confusion respecting this question of cash. It was not the amount of cash that was in hand at the appointed date that the Companies wanted; they wanted the amount of their undivided profits at that date, whether they had got it in actual cash or not. The undivided profit might be much short of the amount of cash a Company might have in hand if they held money belonging to creditors, or if they had not spent the whole of the money raised by them for capital purposes. What they were entitled to was their reserve fund, if they had such a fund, as well as the undivided balance of profit and loss, if, in their prudence, they had not divided the whole of their earnings; and they also wanted to be sure that there was no break in the periods at which the dividends were paid to their proprietors pending the award. On these points they had been met, and they had been decided in their favour. A matter of immense importance to the Grand Junction Company was the repayment to them of the amount they had paid, and which they had yet to pay, in interest on the Staines reservoirs stock. This was a matter which was not of so much importance to the West Middlesex Company, because if the repayment were made to that Company, it would simply be on account of the ratepayers, and it would therefore have to be handed over. It was a matter of importance to the Grand Junction Company and the New River Company; but the latter could afford to look with comparative indifference on an amount of money which, to the Grand Junction Company, would be of very great importance. Up to Dec. 31 last, they had paid about £30,000 on account of interest on the Staines reservoirs stock; and by Dec. 25, 1903, they would have paid another £26,000 or £27,000, making altogether £56,000 or £57,000, the repayment of which they claimed. This was one of the most important points as regarded this Company which would come before the Arbitrators, because it was not only the amount of the money that they wanted, but it was that they might say that the money had been paid out of dividends; and in calculating the value of this Company's property, the money paid for interest on the Staines reservoirs stock must be included as part of their dividend-earning powers. From these reservoirs the Company had derived no benefit, nor would they do so, owing to the Purchase Bill; and they surely ought not to have to bear a loss for having done so much as they had done in this matter for London. They therefore had to be repaid this money, and with interest, he should say from the time that the payments were made; and these sums had to be added to the dividends they had paid year by year, and the money that they had put by. In this way, it would be seen that for some years the Grand Junction Company had been earning gradually from 9 to 9½ per cent., and from 9½ to 9¾ per cent.; while now they were starting on the 10 per cent. basis he had spoken of. He also hoped that during the period that yet remained to them they would be able to show a still further small improvement. When the Staines reservoirs came to be used, an ample return would be obtained by the Water Board from the outlay on them. The Company's concern had to be taken over and paid for on their present district as it stood, and it was fully supplied with water. Houses could be built in their district, and they could be supplied without recourse being had to Staines. The Company, therefore, had a property of constantly increasing value; and this brought them to the question of back dividends, as to which they would have a right to consideration before the Arbitrators. After recognizing the services which had been rendered to the Company before the Joint Committee by their Solicitor (Mr. Bonner Maurice) and their Counsel, the Chairman stated that their Bill in Parliament had passed both Houses, and only awaited the Royal Assent. It gave the Company power to raise £100,000 of debenture stock; but the Directors would not raise any of this money before they were obliged to. Like all money raised of late years by companies under Acts of Parliament, it was subject to a sinking fund. At present, their Company had no sinking fund. He was glad that they had obtained the power to raise this stock, because it put them in a perfectly secure position to get any amount of money they were likely to require between the present time and the time when their undertaking was handed over to the Water Board. As soon as the Money Market was in a somewhat better position, the Directors would arrange to issue the remaining £15,000 of the Company's 4 per cent. perpetual debenture stock. The money thus obtained would help to carry them along for some time.

Mr. FRANCIS TAGART seconded the motion, which was carried unanimously.

The CHAIRMAN then proposed the payment of the dividends recommended for the past financial half year—namely, at the rate of 8 per cent. per annum on the £50 "A" and £25 "B" shares, 7½ per cent. per annum on the £25 "C" shares, and 7 per cent. per annum on the £50 "D" shares.

Sir J. C. R. COLOMB, K.C.M.G., M.P., seconded the motion, which was carried unanimously.

The CHAIRMAN afterwards proposed the following resolution: "That

No. 545 .. .. .. 12s. 6d.

Richmond's

"SUNSHINE."

This is what was needed at the Isle of Wight last Friday!

as the remuneration received by Mr. Walter Hunter as Engineering Director under the resolutions passed by the general assemblies of Dec. 11, 1895, and Dec. 9, 1896, has averaged £1446 per annum, and as it is desirable to fix the minimum amount to be received by him under those resolutions, the arrangement made with Mr. Hunter in 1896 be confirmed, with the proviso that should his remuneration as Engineering Director be less than £1500 in any year, the difference of amount shall be paid to him." He warmly commended the services rendered to the Company by Mr. Hunter.

Mr. TAGART seconded the resolution, which was carried unanimously.

Mr. HUNTER, in reply, stated that he had given the best of his work to the Company. He also recognized the assistance which he had received from an admirable staff.

The retiring Directors and Auditor were re-elected, and a vote of thanks to the Chairman and Directors brought the meeting to a close.

THE GOVERNMENT AND THE LONDON WATER BILL.

Deputation to Lord Salisbury.

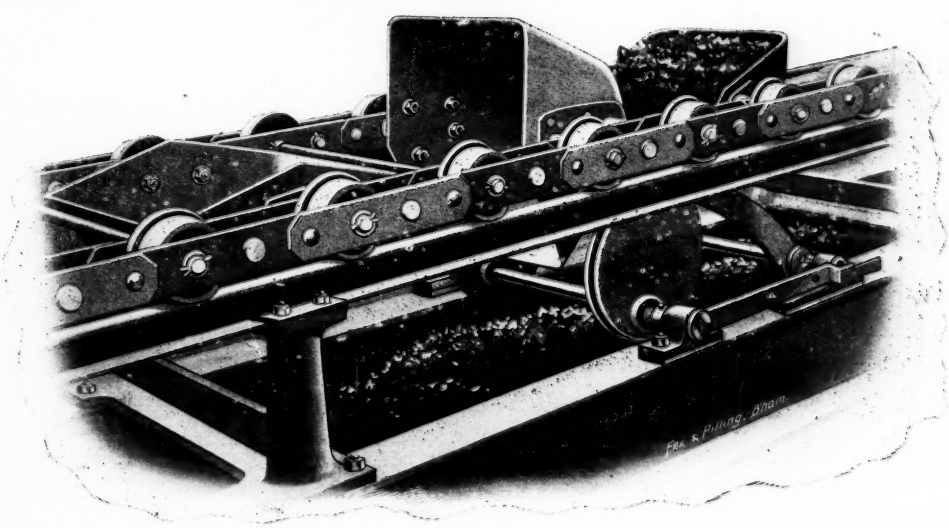
A representative deputation waited upon the Prime Minister at the Foreign Office last Thursday, to urge the importance of carrying the London Water Bill during the present session, and also to insist upon the claims of the Metropolitan Boroughs to the representation given to them by the Bill. Lord Salisbury was accompanied by the President of the Local Government Board (Mr. Long). The deputation was introduced by Sir George Fardell, M.P., and comprised the Mayors of Westminster and the principal boroughs, Mr. B. L. Cohen, M.P., Mr. E. R. Moon, M.P., Mr. Henry Clarke (Deputy-Chairman of the London County Council), and representatives from several urban districts. Speeches having been made in support of the object sought by the deputation, Lord Salisbury said the London Water Question was a most interesting one, and it had the additional charm to him that a controversy had been going on about it for twenty or thirty years. He quite concurred with those who had spoken in the desire that it should be brought to an issue of practical legislation within the present session; and this was the intention of His Majesty's Government. He hoped that no untoward event would happen to disappoint the hopes and anticipations of the deputation; but for this purpose the Government required assistance. What they depended upon was the support of those who commanded the majority of the House of Commons to put their shoulders to the wheel and push the thing through. There was too much inclination for members of all parties, when June faded into July, to think that it was very easy to compromise the matter, or let it stand over till next year. He entirely concurred with the deputation that unless they settled this matter now, it would be very difficult to settle hereafter. He entirely agreed that the present form of the Bill was the best that they could attain. They had fought the battle for so many years that it was not easy to get the proposal put into a perfect scheme—in fact, a perfect scheme was not to be attained. What they wanted was something workable; and, having got that, they should not be particular about the details, or annoyed that something to which hitherto they attached importance had to be thrown aside in order to get the Bill through. This was the only way the Bill could be carried. He earnestly hoped the deputation would succeed; but it would largely depend upon their own efforts whether or not the Bill passed this year. Sir George Fardell, in thanking Lord Salisbury for his reply, said they had listened to it with intense satisfaction, and they hoped, by their united efforts, to ensure the passing of the measure.

NEW WATER-WORKS AT PITTSBURGH.

Some five or six years ago, a Commission was appointed to investigate the character of the water supplied to Pittsburgh, and suggest improvements. The water is drawn from the Alleghany River; and its quality may be judged by the fact that the average death-rate from typhoid fever in the six years ending December, 1896, was 84 per 100,000. Mr. Allen Hazen was appointed Consulting Engineer; and about three years ago a report was made in which the construction of large sedimentation and filtration plant was advocated. The sedimentation basins were to hold 50 million gallons, and the filter-beds an area of 25 acres. These were to work in conjunction with a covered reservoir, and a tunnel under the river to the existing pumping-station. The report was approved all round, and the work is now in progress. It is estimated that there will be necessary 460,000 cubic yards of excavation, 100,000 cubic yards of embankment, the same quantity of general filling, 24,000 cubic yards of puddle, and 58,000 cubic yards of concrete. The following particulars of the scheme appeared in a recent issue of the "Engineering Record."

The water is drawn from the river by engines; the pipe being 72 inches in diameter. It is made of riveted steel, surrounded with portland cement concrete. The raw water is delivered into a receiving basin placed between the two sedimentation basins. From this it flows through seventeen 20-inch outlets into the sedimentation basins. There are two rows of sixteen 16-inch inlets leading to the basins, which are provided with the same number of outlets, also 16-inch, which deliver into a 60-inch main. These mains feed the filter-beds, and are joined together by a 48-inch main, the size being reduced after the connections to the first filter-beds in each case are taken off. There are in all 25 filter-beds, each having an area of as nearly as possible one acre. The filters are separated into three groups, each supplied from a single controller-house. Two of these groups are further subdivided into two sets by employing two regulator-houses in each group where the rate of flow from the system of underdrains is regulated. The levels of the filter surfaces vary from 64·7 to 61·1. The filters are partly in excavation and partly in embankment, and are arranged in groups with wide embankments, each group being subdivided by cross walls into two or three beds. Most of the walls are 9 feet high, those on the outside being 2 ft. 6 in. thick

LITTLES' "ALL-WAYS" CONVEYOR.



Every foot of it useful, Feeds to store with top run, and Draws off supply from bulk on return. It works "all-ways," — horizontally, diagonally, or vertically.

SOLE MAKERS—

NEW CONVEYOR CO., LTD., SMETHWICK.

for the top 4 feet, then battered 1 to 5 to the bottom. Where the beds are in excavation, the walls are not carried so low as elsewhere—being only from 6 to 8 feet deep; and the bottom is sloped up at the rate of one vertical to two horizontal to meet them. The cross walls are 3 feet thick for the top 4 feet, and are then battered 1 to 3·33 to the bottom, where they are 6 feet thick. The specifications for the concrete work on these filters, as well as for the floors of the basins previously described, stipulate for a mixture of one volume of cement, three volumes of sand, and five volumes of ballast. The floors are divided into squares of about 50 square feet by suitable metal forms extending partly through the concrete. The openings thus left are filled in with an asphalte mixture, which will remain soft at freezing temperature. The surface of the concrete is served with ½ inch of cement mortar composed of 1 part of cement and 1½ parts of sand.

The sedimentation basins are on slightly higher ground than the filters, the latter being between the river and the basins. The natural hills form the banks of the basins on one side. The built-up embankments are constructed of material procured from the site, and have 1 to 1½ slopes. Three-inch layers of the best clayey and the best gravelly material from the excavation are spread alternately, freed from stones and perishable matter, and thoroughly mixed by harrows or otherwise. This mass is rolled in 6-inch layers by a 10-ton grooved roller. The inner slopes and some other parts of the embankments of the basins have a lining of puddle consisting of one part of plastic clay free from loam, mica, and other foreign matter, and two parts of sandy gravel not more than 2 inches in size. The clay is placed in 6-inch layers, and worked into proper condition.

The under-drainage system of each filter includes a 24-inch earthenware collecting drain running nearly the full length of the bed from a manhole at one end to a cast-iron pipe through the embankment. The earthenware pipes have their bells cut away; thus increasing the facility with which they are laid, and keeping them near the floor. They are also furnished with compensating orifices placed between the bend and the branch of the main collecting drain. These orifices have openings 4½, 5, and 6 inches in diameter. By their use, it is possible to make the fractional resistance of the under-drainage system uniform over the whole bed, while gaining the advantage of only using a few sizes of earthenware pipe.

The filter-beds are constructed in the following manner: On the floors and surrounding the under-drains is placed gravel or broken stone having an average depth of about 1·1 feet. It is arranged approximately thus: The lower 7 to 9 inches consists of broken stone or gravel which remained upon a screen with a mesh of 1 inch, and had very few stones more than 2 inches in diameter. Above this are placed 2½ inches of broken stone or gravel which passed a screen with a mesh of 1 inch, and which remained upon a screen with a mesh of ⅜ inch. Above this are placed 2½ inches of broken stone or gravel which passed a screen with a mesh of ⅜ inch, but which is coarser than the ordinary sand, and free from fine material. The materials for all the layers are hard, durable stone, broken and screened to the proper sizes, or gravel screened from river deposits or banks of a sandy nature.

The gravel is not placed within 6 feet of the inlet chambers, nor within 2 feet of the outside or cross walls; these spaces being reserved for filling with sand. The sand is clean Alleghany River sand, washed to free it from clay, dirt, coal, or organic impurities; and it was specified that it was not to contain more than 1 per cent. of lime and magnesia taken together and calculated as carbonates. It is deposited in three layers of about equal depth. The main collector of every filter-bed discharges into a cast-iron pipe leading to a regulator chamber. Each pipe is furnished with a Venturi meter. A separate compartment is provided for the outlet of each pipe, which is fitted with a gate-valve enabling the discharge to be closely regulated. As there are only five of these regulator-houses for the entire plant, this regulation is a much simpler matter than where each bed has its own independent regulating-house. Pressure pipes from the filter, the meter indicating its discharge, and gauge-wells in the regulator chambers are connected with indicators, so that the factors determining the work of each bed can be read on suitable scales at a glance. The mains carrying the filtered water join a 68-inch riveted steel pipe leading to the pure-water reservoir.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

I sent on to you earlier in the week the account which appeared in the "Dundee Advertiser," on Monday last, of the visit of Mr. William Foulis, of Glasgow, to the Dundee Corporation gas-works. [It will be found on page 1699.] It seems that Mr. Foulis is not in the position of being Consulting Engineer to the Corporation, but is simply a friendly adviser. There appears to have been a misunderstanding upon this point, for it was held by many that Mr. Foulis was Consulting Engineer. With him at the helm, the feeling was that there was no possibility of anything going wrong. A very little reflection will show that this was altogether a "Fool's Paradise." The expenditure on the reconstruction of the works has been about £90,000. Had Mr. Foulis been Consulting Engineer, he would be entitled to fees according to custom; and the members of the Corporation of Dundee would, I fancy, have made wry faces if they had been asked to pay nearly £2000 to him. They knew they were not paying any such sum; and the conclusion is irresistible that if they thought upon the matter at all, they must have concluded that Mr. Foulis's services were being got, in some most exceptional way, in large measure as a favour—an arrangement not to be dreamt of, and which, indeed, would not have been to the credit of the Corporation. Having brushed this cobweb aside, we are ready to consider what it is that Mr. Foulis has been able to do for the Corporation of Dundee. He has, in a visit extending over only a few hours, disclosed the weak spot in the reconstructed works. It is the construction of the retort-bench that is at fault. I gather from the account which is given that both the design of the furnaces and the workmanship are, according to him, blameworthy. It is evident the flues do not carry the heat throughout

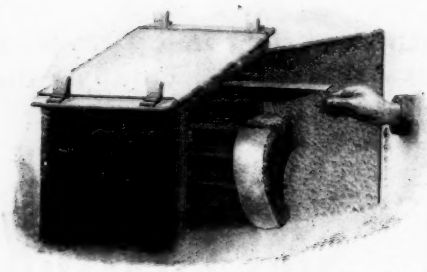
'PARKINSON' GAS COOKERS

(*Crown Series*).

EMBODY MANY IMPORTANT IMPROVEMENTS.

(*See below*).

Patent Sliding Meat Hook.



PARKINSON and W. & B. COWAN, Ld.

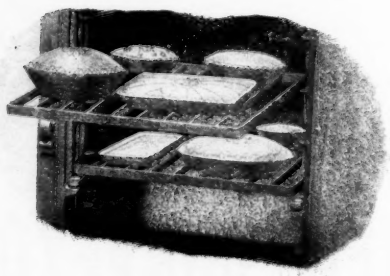
(PARKINSON BRANCH)

LONDON,

AND

BIRMINGHAM.

Patent Self-Locking Oven Grids.



the whole of the oven. The popular expression is that baffles are required to distribute the heat. Most probably this is meant to cover the enlargement or rearrangement of the flues. Good results, it is said, have been obtained hitherto with what has now failed. But it is necessary, along with that view, to remember that the settings are now twelves, and that the heat has consequently much farther to travel. In the case of Mr. Foulis's own works at Dawsholm, two or three settings of twelves were put in, as an experiment, the problem being the heating of them; and it is significant to recall that he has, after a long trial, given up the system of firing which is universal in regenerative settings, and fires them now with gas generated in producers outside the retort-house. The increase in the number of retorts is one condition which would affect the heating. Another, and a very important, condition to be taken account of, is the calorific value of the gas used in the firing. I presume that as one coal produces a different gas from another, so will the gas from one coke be richer or poorer than the gas from another. This could only be determined by test or experiment, as to which, it may be pointed out, there is an Analyst in the Dundee Gas-Works, who could have tested, and the Manager could have experimented. Mr. Foulis has suggested that the gases which go up the chimney should be examined. Evidently he believes that there is not complete combustion going on. Upon this subject, the opinion which a friend of mine gave some years ago is very pertinent. According to him, the value of providing enough air supply is not sufficiently appreciated. He instanced a case where disaster was brought about by an arrangement which he considered faulty. Generator gas will not burn unless it is fed with air—it will pass out into the flue unconsumed; and on getting there, it will actually draw air down the chimney, and will then burn. So that less, and not more, heat is got when the air supply is restricted. If that should be the case in Dundee, it is not so much the gases going up the chimney which should be looked into, as the gases leaving the furnace before they meet the air. The workmanship of the retort-settings is a subject which cannot be considered without a feeling of disappointment. Mr. Foulis says that he himself required to live almost night and day in his own works when they were being reconstructed. What a revelation is here of the ways of the working man. Mr. Foulis's designs were perfect; but he could not get working men to adhere to them unless he stood over them. One faulty point in a setting would bring the whole to ruin. Therefore it is necessary that the man who is to work the structure should see that every brick is properly laid before it is covered up. Mr. Foulis is not by any means pessimistic. He believes that, with the reconstruction of the settings, results will be obtained which should enable the Corporation to get out of their entanglement. It will, of course, take time; but it is reassuring to be told that the situation is not hopeless. The Corporation Gas Committee have had an opportunity of expressing themselves upon the subject; and that they have done so somewhat strongly need not be wondered at, when we consider the state of panic into which they have been thrown. It is to their credit that they have not come to any hasty resolution as to what they may do. The Committee have passed the accounts for the past year, and adopted the estimates for the current year. That Mr. Foulis considers the Corporation are not altogether free from liability for the present state of matters, may be gathered from his recommendation that the accounts of the undertaking should be altered so as to conform to the Board of Trade model. This has already been done; and copies of the new style of accounts have been circulated.

The proposal that the Corporation of Coatbridge should take over the undertaking of the Coatbridge Gas Company has been smouldering for a long time. It has at last become active. On Thursday of this week, the Town Council held a private sitting on the subject, and resolved to offer the Company twenty-four years' purchase of their maximum dividends of 10 and 7 per cent. respectively. So far as I can make out, the Company have £12,000 of stock at 10 per cent., and £52,000 at 7 per cent. I make the price out to be about £111,000. The yield to shareholders would be a little over 2¾ per cent.

The annual meeting of the Leven (Fife) Gas Company was held on Thursday. It was reported that the consumption of gas during the year had been 16½ million cubic feet—an increase of 1½ million cubic feet. A dividend of 5 per cent. was declared; and a bonus of £20 was voted to Mr. Readdie, the Manager, on account of extra work.

During the past year the quantity of gas manufactured in the Alloa Corporation gas-works was 88,602,000 cubic feet—an increase of nearly 10,000,000 cubic feet. The profit on the year's working was over £350. In accordance with a previous arrangement, the deficit on the electric lighting account will be paid out of the gas profit.

The Dumfries Town Council last week entered into contracts for 9000 tons of coal for use in the Corporation gas-works during the current year. The average price is 15s. 3·2d. per ton. They also contracted for 225 tons of oil, at the price of £2 7s. 9d. per ton, which includes a royalty of 2s. 6d. per ton. Resuming consideration of the subject of a new gasholder, they agreed to let the contract for the construction of the tank to Messrs. Tilburn and Co., of Dumfries, at the price of £3513. As to the holder itself, they resolved to give it further consideration, along with the Manager. Upon this subject, Mr. Thomson said that he had opposed the construction of so large a holder as was proposed, but he had found that the difference in cost was so immaterial that he had resolved to waive his objection. Besides, he had had a conversation with Professor Capper, who was of opinion that gas will be more used in the future than it is now. The Corporation agreed to give free gas for illumination purposes on Coronation Day.

It was reported to the Dunfermline Town Council on Monday that during the past year the quantity of gas manufactured in the Corporation gas-works was 98,377,000 cubic feet—an increase of 11,452,000 cubic feet upon the output in the preceding year, equal to 13·17 per cent. The Council had before them a report by Mr. Alexander Wilson upon the proposed extensions at the gas-works. Mr. Wilson wrote: "I consider the scheme, as a whole, a practical one, well suited to the conditions and size of the works, and, as the output of gas increases, likely to give even better results than are shown in the report of your Manager on the subject. The Council let contracts to the amount of £2677 for the fitting up of coal and coke handling plant,

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by the use of which a yearly saving of £416 is estimated. Bailie Horley expressed great gratification at the position of the undertaking. The auditing of the accounts for the past year, he said, had scarcely been completed; but he was in a position to say that they would have a very handsome surplus. The amount is stated to be about £2500; and it is expected that the price of gas will be reduced by about 6d. per 1000 cubic feet. At present it is 3s. 11d.

It was reported to the Peterhead Town Council this week that the make of gas during the past year showed an increase over that of the preceding year equal to 18·54 per cent., and over that of two years ago equal to 47·62 per cent.

The Dunbar Town Council have fixed the price of gas at 4s. 7d. per 1000 cubic feet till November, and from then till May at 4s. 2d. per 1000 cubic feet. They also voted £10 as an honorarium to the Manager (Mr. T. O'Neill) for his good services.

The Perth Town Council met on Monday; and regarding the meeting, a newspaper published in the city said it was remarkable for the few passages of arms that took place. One of the incidents which the Editor seems to regard as characteristic of the Council arose over the minute of the meeting at which Mr. Thomas Newbigging began his inquiry into the alleged increases in the gas bills. The question raised was whether the Gas Treasurer was one of those who were appointed to accompany Mr. Newbigging. The Clerk said that his minute was correct, and that he had nothing to do with what took place after the meeting. The minute was altered so as to include the Gas Treasurer as one of the party. There was a long discussion upon a proposal to sell a portion of the site of the old gas-works to a Co-operative Society, for the erection of dwellings for the working classes. The sale was so far completed that Lord Provost MacGregor held that the Council were morally bound to go on with it. A section of the Council, however—and, as it proved, the majority—had come to be of opinion that it would be unwise on the part of the Corporation to dispose of land so centrally situated as this is, because the probability is that it will be required for some municipal purpose. This view was adopted by thirteen votes to ten. It was not mentioned in the discussion; but I should think that the loss of the price of this ground will affect the capital account of the Corporation gas undertaking.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 14.

Sulphate of Ammonia.

The market remains without animation; and prices are again easier—the closing quotations being £12 10s. per ton f.o.b. Hull, and £12 13s. 9d. to £12 15s. per ton f.o.b. Liverpool. Consumers abroad, being able to buy July forward at a discount, have been quite off the market for June delivery, and speculators who have June contracts to cover have been in no hurry to buy. Parcels offered have consequently had to be disposed of at the decline. There has also been second-hand selling. In the forward position, there is nothing to report; makers quotations being unaltered, while buyers are altogether indifferent.

Nitrate of Soda.

This is quiet in all positions; and the closing spot prices are 8s. 6d. and 8s. 9d. per cwt., for ordinary and refined qualities, respectively.

LONDON, *June* 14.

Tar Products.

The market is quiet all round, and considerable depression prevails in every article except pitch, for which very high prices are being realized, especially for home consumption—the demand for asphalting and electrical purposes being very considerable. In 90 per cent. benzol, business is reported at 8d. for July-September delivery; but this was at an outport—London makers holding for 8½d. over this period. In 50-90 per cent. business has been done for home consumption at 7d. delivered to consumers' works; but this is believed to be only for July delivery. In toluol and solvent, prices remain purely nominal. There is no business doing in either of these articles. This also applies to anthracene, which does not appear to interest consumers at all. Creosote is still very quiet, especially in the North of England, where consumers are anxious to sell considerable quantities for both prompt and forward delivery. There has evidently not been such a good demand as was expected for this article, although, as far as London is concerned, prices are fairly well maintained. Crude carbolic is decidedly easier. Consumers will not pay more than 1s. 10½d. for June; while for July-December, 1s. 10d. is the outside value. Crystals are also very dull, and 5⅜d. is reported to have been accepted for 39-40's.

The average values during the week were: Tar, 16s. 6d. to 21s. 6d. Pitch, London, 46s. to 47s.; east coast, 43s. 6d. to 44s.; west coast, 38s. 6d. to 39s. Benzol, 90 per cent., 8d.; 50-90 per cent., 7d. Toluol, 8⅜d. Crude naphtha, 2¾d. to 3d.; solvent naphtha, 9d. to 9¼d.; heavy naphtha, 9d. to 10d. Creosote, London, 1¼d.; North, 1d. Heavy oils, 1⅝d. Carbolic acid, 60 per cent., 1s. 10½d. to 1s. 11d. Naphthalene, 35s. to 50s.; salts, 21s. 6d. to 23s. Anthracene, "A," 1½d. to 1⅝d.; "B," 1d. nominal.

Sulphate of Ammonia.

The market closes easier all round. Beckton have very little to spare for June-July, and are not actually offering; but the price for these months is nominally £13, while for October-March £11 17s. 6d. is the market quotation. In Hull, sellers ask £12 12s. 6d.; but consumers will not exceed £12 10s. In Leith, sellers ask £12 15s.; but consumers will not offer more than £12 12s. 6d. Probably £12 13s. 9d. would be accepted for June-July shipment. The Liverpool market is reported to be easier for both prompt and forward delivery.

At the annual meeting of the Devonport Water Company last Thursday, the Directors were authorized to pay such a dividend as they might think fit next Michaelmas.

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COAL TRADE REPORTS.

Lancashire Coal Trade.

The generally steady tone throughout the coal trade of this district reported last week is being well maintained. The exceptional weather conditions check any very material falling off in requirements for house-fire purposes; while the continued irregular working of the collieries restricts the output of the pits. House-fire descriptions continue in good demand for the season of the year, with no stocks accumulating at collieries. Prices for the most part are firmly held to at the basis rates of 13s. 6d. to 14s. per ton at the pit for best Wigan Arley, 12s. to 12s. 6d. for Pemberton four feet and seconds Arley, and 9s. 6d. to 10s. for common house coal. The lower descriptions of round coal, for which there is a moderate inland demand for iron-making, steam, and general manufacturing purposes, with steadily increasing requirements for shipment, are also maintaining a steadier tone than seemed probable a short time back. Collieries have so far no surplus on their hands that they are anxious to push on the market, and generally they are not at all eager about contracting forward at anything materially under current rates. At the pit, quotations for steam and forge coals on inland sales average about 8s. 6d. to 9s. per ton. For shipment, although there are some inferior sorts that might still be bought about 9s. 6d. to 9s. 9d. per ton, 10s. to 10s. 3d. are about the average quotations for good qualities of steam coal, delivered at the ports on the Mersey. On forward steam and forge coal contracts, about 3d. to 5d. under full current rates might be accepted. This, however, would represent the maximum concession that collieries seem disposed to entertain. With regard to gas coals, there is still a good deal of business to be settled; but it would appear questionable whether buyers who are holding back from concluding their contracts are likely to gain much advantage, as coalowners are showing more firmness in adhering to the generally accepted arrangement of not conceding more than 1s. for best sorts, and 1s. to 1s. 6d. for inferior descriptions of gas coals on last year's rates. Some of the lowest qualities of gas coal might be bought at 8s. 6d. to 8s. 9d.; but for ordinary descriptions of Wigan four feet, 9s. is the average figure, with best Wigan screened Arley gas coals at 10s. to 10s. 3d., and good screened Arley slack, suitable for gas making, quoted about 7s. 9d. to 8s. at the pit. The better qualities of Lancashire engine fuel are in fairly good request. Prices are being held to on the basis of late quotations, averaging 6s. 6d. up to 7s. per ton at the pit for some special descriptions; and the present production is mostly moving away freely at these figures. Inferior sorts of slack remain pretty much the drug they have been for some time past, chiefly owing to surplus supplies offering from Derbyshire and Staffordshire. For common Lancashire slack, 4s. 6d. to 5s. remain about average figures, with medium sorts of slack obtainable in Derbyshire at about 2s. 6d., and in Staffordshire at 4s. to 4s. 6d. at the pit. The coke trade continues strong, both in foundry and furnace qualities. Quotations in Lancashire are firm at 22s. to 24s. for best foundry sorts, and 13s. 6d. to 14s. 6d. for best furnace cokes at the ovens.

Northern Coal Trade.

There is a better demand for some kinds of coal, as users desire to accumulate a little stock before the holidays. Best Northumbrian steam coals are firm at 11s. 6d. per ton f.o.b.; and the collieries producing this quality are well employed. Second-class coals are in less request; and the prices are weak and lower than they have been, at from 9s. 3d. to 9s. 9d. per ton f.o.b. Steam smalls are now more plentiful, and are easier in price at 5s. per ton. The Durham coal trade is now at a very dull season of the year; and with a limited need, the prices show ease. Coking coals are dull, some of the foreign contracts having been diverted apparently. In the gas coal trade, there is a quiet tone, the consumption being now at its lowest point, and the price varying from 8s. 3d. to 9s. 3d. per ton f.o.b., according to quality. Some contracts for moderate quantities of coal are being negotiated, and the expectation is that the price will be on a basis equal to from 8s. 6d. to 8s. 10d. per ton f.o.b.; but a week or two will declare the actual results. Coke is rather steadier, the demand having improved a little. Best Durham coke for export is 17s. to 17s. 6d. per ton f.o.b., and blast-furnace coke is steady at last week's price. Gas coke varies a little in quotation; but the limited production steadies the price.

Scotch Coal Trade.

The market continues in a slack condition, the foreign demand being still the greater weakness. Small sorts are being most inquired for. There is a proposal to further reduce the wages of the miners, which may lead to still lower prices. The prices quoted are: Main 8s. 3d. to 8s. 6d. per ton f.o.b. Glasgow, ell 9s. 3d. to 10s. 3d., and splint 9s. 3d. to 9s. 6d. The shipments for the week amounted to 196,299 tons—a decrease of 7317 tons upon the previous week, and of 6869 tons upon the corresponding week of last year. For the year to date, the total shipments have been 4,245,794 tons—an increase of 225,084 tons upon the same period of last year.

Messrs. Ritchie and Co., of Southwark, have been entrusted with the warming, by means of their patent "Lux-Calors," of the pavilion now being erected on the west terrace of Buckingham Palace, for the reception of the King's Coronation guests.

The Wath-on-Dearne and District Gas Company have placed an order with Messrs. R. Dempster and Sons, Limited, of Elland, for a gasholder 80 feet in diameter and 20 feet deep, prepared for telescoping, in a steel tank 84 feet in diameter and 20 ft. 6 in. deep.

Mr. C. V. Bennett, Manager of the Herne Bay Gas Company, has issued a circular setting forth the advantages of gas-stoves, from the several points of view of economy, readiness, cleanliness, labour saving, and efficiency. Unfortunately, the hot weather in which the gas-stove is found to be so useful an auxiliary in the household has not come to us yet this summer; but we live in hope that it may soon arrive, and then the inhabitants of Herne Bay will appreciate the value of Mr. Bennett's observations, and the facilities afforded by his Company for putting it to the test.

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PORTSEA ISLAND GASLIGHT COMPANY.

(FLATHOUSE WORKS, PORTSMOUTH.)

WANTED, a First-Class Foreman MECHANIC for the above Works. Must be capable of taking control of Fitters, Turners, and Blacksmiths, with their Labourers, numbering about twenty men. Must have a thorough knowledge of all classes of machinery used in a large Gas-Works, including Compressed Air Stoking Machinery, High-Speed Steam-Engines, Gas-Exhausters, Gas-Engines, Pumps, Boilers, and generally Mechanical Appliances used on a Gas-Works. Wages 45s. per week, with House and Garden only.

Apply, with *copies* of not more than three Testimonials by June 21, to J. D. ASHWORTH, Engineer, Gas-Works, PORTSMOUTH.

COUNTY BOROUGH OF STOCKPORT.

(GAS AND ELECTRICITY DEPARTMENT.)

JUNIOR DRAUGHTSMAN.

THE Gas and Electricity Committee are prepared to receive APPLICATIONS for the position of JUNIOR DRAUGHTSMAN, who must have some knowledge of levelling.

Commencing Salary from 20s. to 25s. per week.

Applications, accompanied by copies of not more than three Testimonials, to be addressed to the Chairman of the Gas and Electricity Committee, and endorsed "Draughtsman," on or before June 25 next ensuing.

Canvassing the Committee strictly prohibited.

By order,
ROBERT HYDE,
Town Clerk.

Stockport, June 10, 1902.

CITY OF BIRMINGHAM.

(GAS DEPARTMENT.)

THE Gas Committee invite applications for the position of WORKS ENGINEER of their Windsor Street Works. Candidates must not be less than 30 Years of age, or more than 45, and must be thoroughly acquainted with modern methods of Gas Manufacture, including Carburetted Water Gas and the working of Inclined Retorts. A knowledge of Distribution and the Construction of Gas-Meters is desirable, and Candidates must also have had experience in designing and carrying out up-to-date Gas-Works Plant.

Commencing Salary, £600 per annum.

Applications must be submitted by the 30th of June inst., giving full particulars of Age and Experience, with Testimonials and References, addressed to the Chairman of the Gas Committee, Council House, Birmingham, and endorsed "Application — Works Engineer."

G. HAMPTON BARBER,
Secretary.